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COMPRESSED AIR MAGAZINE

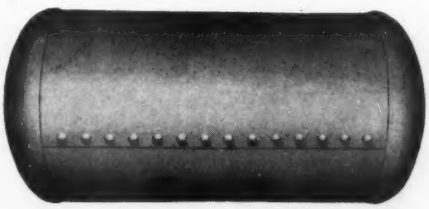
DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

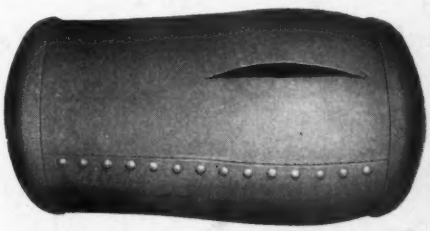
Vol. xxiii **MAY, 1918** **No. 5**

Scaife Copper Brazed Tanks

The Ideal Containers
For Compressed Air and Gas

These cuts are from actual photographs of a Scaife Copper-Brazed Tank purposely tested to destruction. Notice the distorted shape of the burst tank and the splendid condition of all the copper-brazed joints, proving conclusively that they are stronger than any other part of the tank.





This tank was 12″ diameter, shell 7-64″, heads 3-16″; tensile strength of the steel, about 58,000 lbs. The tear in the shell occurred when the applied pressure reached 1,035 lbs. per sq. in.; all the brazed joints remaining intact. Similar tests have been frequently made by entirely disinterested tank experts with the same results as in this case.

Hundreds of our brazed tanks made over twenty years ago are still in service. The copper coating around the seams protects these parts from corrosion; so that they retain their original high efficiency after the material in other parts of the tank, as a result of long usage, may have become badly rusted.

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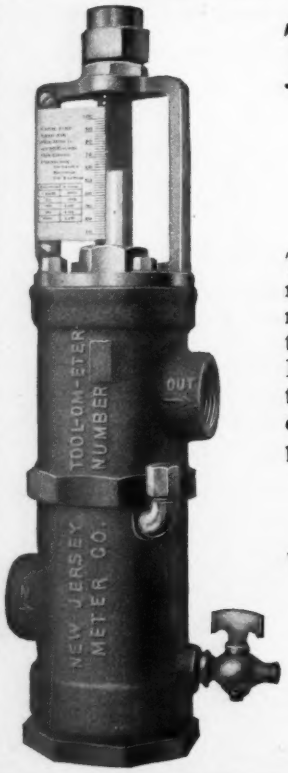

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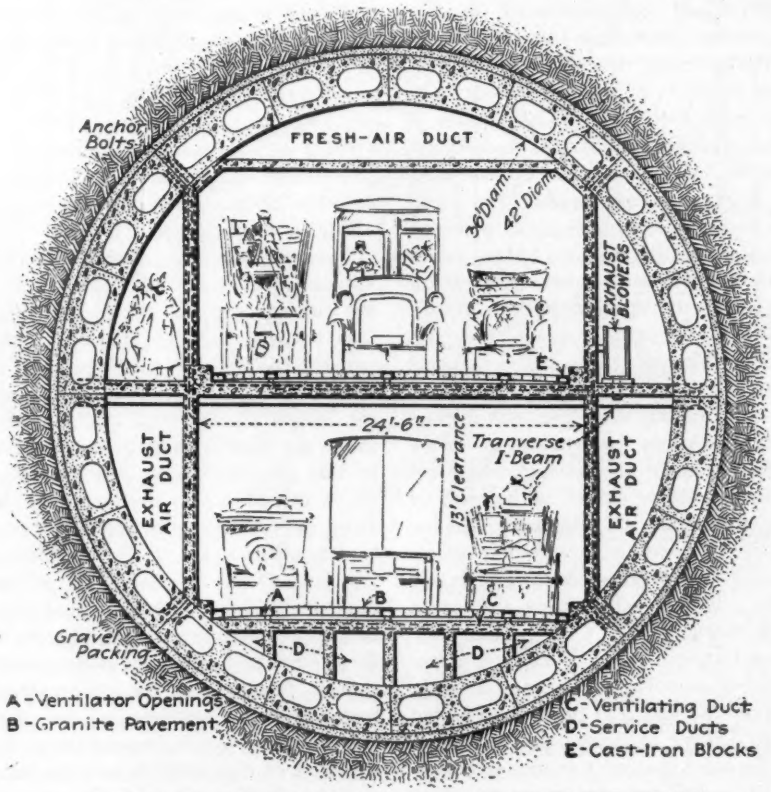
EVERYTHING PNEUMATIC

Vol. xxiii MAY, 1918 No. 5



SECTION OF PROPOSED HIGHWA Y TUNNEL UNDER THE HUDSON

NOVEL MULTIPLE-AIR-CHAMBER SHIELD FOR LARGE TUNNELS

By John F. O'Rourke*

The recent joint action of the Bridge and Tunnel Commissioners of New York and New Jersey, adopting the project recommended by their consulting engineer, Gen. Geo. W. Goethals, for a shield-driven highway tunnel of 42 ft. diameter across the Hudson River at New York City, involves the employment of a shield nearly twice the diameter of any heretofore used. In connection with a proposal to construct this tunnel for the sum of $12,000,000, the writer has designed a shield of radically new type. Application has been made for a patent on this shield construction.

*President and Chief Engineer, O'Rourke Engineering Construction Company, New York. Article reprinted from Engineering News-Record, March 21, 1918.

The shield has multiple air chambers in its forward part, each ending 3 ft. in front of the chamber immediately above it, thus enabling the excavation to be done in separate vertical faces, the escaping compressed air from each chamber entering the ground forward of the excavation in the chambers above. Means are also provided to close the space between the tail of the shield and the tunnel lining.

HOW THE AIR ESCAPES

In considering the problem of a multiple-air-chamber shield and the behavior of the compressed air after its escape into the ground from its various levels, it is well to give attention to the manner in which escaping compressed air from pneumatic caissons makes its way through the ground to the surface. In the sinking of caisson foundations for river piers and large buildings, it has been found that the escaping air is dispersed for a considerable distance from the caissons before reaching the surface. While the greater part of the air ascends directly upward within narrow limits, in some cases of caissons for buildings it has been found escaping into cellars as much as 300 or 400 ft. distant. Experience has shown that where two caissons are being sunk in close proximity to each other the escaping air in the ground from the lower air chamber where the pressure is much higher caused no increase of pressure in the upper air chamber, showing that as the compressed air ascends it expands in proportion as the pressure is reduced in the groundwater. This is self-evident and needs no extended statement.

It is this principle of the reduction of pressure in escaping compressed air as it ascends through the ground that is at the bottom of the new plan for having superimposed air chambers in the forward part of a tunnel shield, in each of which an air pressure would be maintained suitable to the pressure in the groundwater at its front.

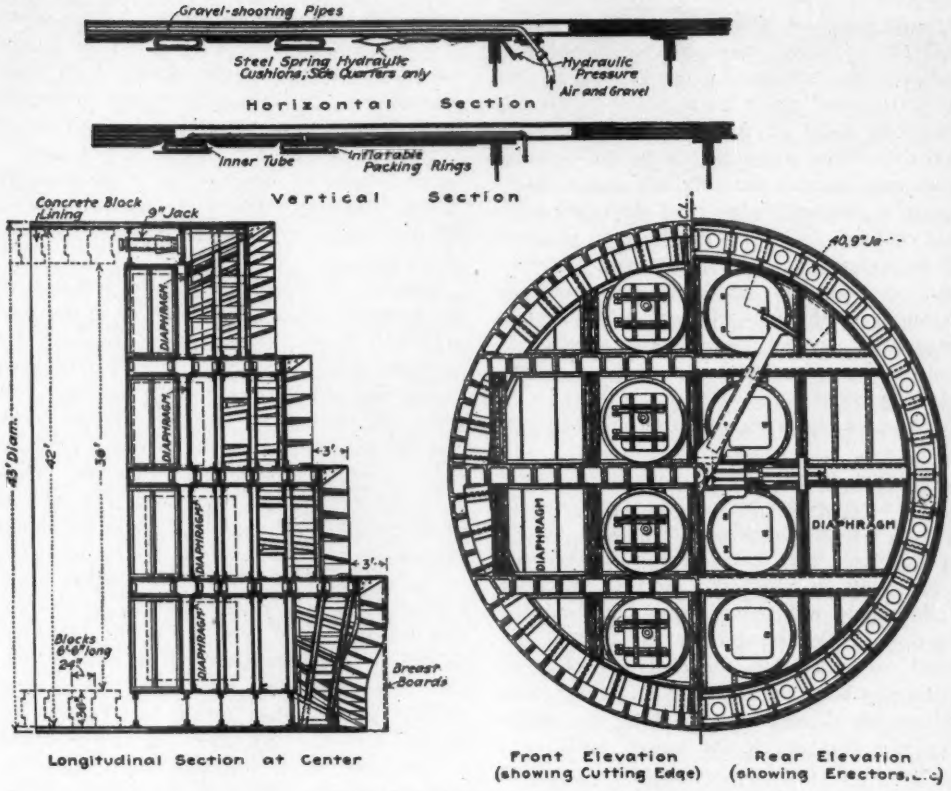
FACE STEPPED BACK FROM LOWEST CHAMBER

The shields heretofore used in the construction of tunnels have been designed for doing the excavation at the front of the shield from the top downward in one vertical plane, the face of which is held in place with breastboards when the material at the face will not stand up by itself; bracing and jacks hold the breastboards in place as the excavation proceeds and while the shield is being shoved forward. The shields have been divided horizontally into two or more levels when the diameter was too large for the excavation operations to be conveniently worked from the bottom, and the platforms forming the levels usually had extensible fronts operated by jacks which were shoved forward, following the excavation, to hold the breastboards during excavation and shove. The same object is attained in the new shield by numerous breast jacks arranged above one another in tiers.

In the longitudinal section of the multiple-air-chamber shield shown here, the roof and top cutting edge of the bottom air chamber extend outward about 3 ft. beyond the roof and top cutting edge of the air chamber above; the cutting edge of the second chamber has a like projection beyond that of the chamber above it, and the other chambers above recede successively in like manner.

The excavation for each shove starts simultaneously in all the air chambers, in line with the cutting edges, so the faces of the excavation are in the same planes as the cutting edges. The floors of each chamber, except the bottom one, extend forward of the excavation the length of the step. When the shove is made, the floor of each chamber slips forward so that after the shove it is the length of the shove in addition to the length of the step in front of the face of the excavation. It is to be remembered that, in the chamber below, the top face of the excavation is at the cutting edge of the floor of the chamber above. This enables the men in each chamber to look after the ground into which the cutting edge is being shoved, to pull down the top breastboards and bring in small boulders as the cutting edge reaches them, or, in case a large boulder is encountered that might injure the cutting edge, stop the shove until it is either brought in or blasted. At the end of the shove the cutting edges are out at the position where excavation is started for the next shove.

The bottom air chamber has the bottom of the shield for its floor, as in all shields, and the usual practice of keeping the bottom cutting edge a full shove back from the face of the excavation is followed, as this leaves the ground at the bottom exposed and the presence of rock or boulders is known and taken care of before the shove. In this way all of the shoving is done under the same conditions of observation



DETAILS OF SHIELD CONSTRUCTION

and control in the multiple-air-chamber shield as in the ordinary shield whose only cutting edge is in the circumference.

At the forward end of the jack circle are located diaphragms which form the inner wall of the air chambers and contain air locks which, together with the air-tight floors and sides, make each forward level an independent and workable air chamber with an open front. Each chamber is worked with its own excavating force. This greatly expedites the excavation, which in the case of four levels has four times as many men and requires only one-fourth of the time that would be taken in a shield of one level excavated from the top downward with one-fourth the number of men at work in the shield.

In water-bearing ground each air chamber would be filled with compressed air of suitable pressure for the water in the ground in front of it near the floor, and the unbalanced pressure in each chamber would therefore be approximately that of the height of the air chamber, which under the ordinary practice, would require a cover 1¼ times the height of the chamber. Under this rule the ground in front of the tunnel is sufficient cover for all but the top air chamber, which would require a cover above the top of the shield of 1¼ times the height of that chamber. In the case of an ordinary shield of the diameter under consideration here, the height of cover that would be required above it to retain the unbalanced air pressure would exceed 50 ft., while the multiple-air-chamber shield would require a cover on top of only 13½ feet.

That compressed air cannot enter an upper air chamber from a lower one where the pressure is higher is evident from what has already been stated in regard to the behavior of compressed air that has escaped into the ground from pneumatic caissons. In the case of the tunnel shield, the air escapes into the ground some distance forward of the air chambers above, where it immediately expands to the pressure of the groundwater

through which it is ascending. As it passes in front of each successive air chamber it only has the pressure in the ground at that level, to meet which each chamber has already an equal or greater air pressure, so that there is no possibility of the air escaping from any chamber entering any upper chamber at a pressure higher than that already in that chamber. There is therefore no question of the practicability of maintaining independent air pressures within superimposed air chambers at the forward part of any shield when they project beyond one another in steps which allow the air to expand in the ground outside.

AIR LEAKAGE AT TAIL OF SHIELD SERIOUS IN LARGE TUNNEL

The next question that arises is in regard to the air pressure within the tunnel itself. This is a matter of great importance, as all the accidents that have heretofore occurred under rivers in which the earth at the front of the shield was blown away happened because of the air escaping at the tail of the shield carrying away the cover sufficient to permit the blowout at the front. Even with multiple air chambers at the front, the unbalanced air pressure in the tunnel, still equal to the total diameter, requires a radical change from the present practice in regard to closing the space between the tunnel lining and the tail of the shield. This is done in the new shield by packing. Three rings of steel plates, each about 1 in. thick, are riveted and calked to the tail and spaced apart sufficiently to form recesses; into these are set two inflatable packing rings in sections and mounted on thin metal plates. The bottom of the inflatable packing ring consists of strips of rubber, leather or the like, which project forward in the case of the tube nearest the end of the lining and backward in the case of the tube nearest the tail. These tubes would be connected to high-pressure air pipes through spaces in the skin of the shield, entering the latter inside the jack circle. The tubes would be maintained under pressure except when the shield was being shoved, during which time the pressure would be reduced to lower the friction between the tubes and the tunnel lining. The projecting lip in the case of the one nearest the end of the lining would be forced against the lining by the air pressure like the familiar flap valve, so that when the pressure in the tube was reduced there would still be a pressure contact between the lip and the lining to obstruct the escape of the compressed air. In like manner the projection from the tube near the end of the tail would be forced against the lining by pressure of water seeking to enter, so while the pressure in that tube was reduced the contact between lip and tunnel lining would prevent entrance of water.

Suitable air pressure, or even free air, in the forward parts of the shield or in the tunnel itself, can be maintained by reason of the air-tight and water-tight connection between lining and shield and by the facility with which the reversible doors of the air locks can be operated with the greater pressure either in front or behind the chamber. Thus a tunnel in part above water or ground can be driven, having compressed air in the shield chambers below water and in the tunnel itself.

The shield construction shown makes practicable much larger tunnels than heretofore. The importance of this lies in the fact that tunnels of larger capacity can be built at less cost and occupy less space than the several smaller tunnels that would be required to furnish the same capacity. The larger tunnel is obviously more desirable, particularly in highway tunnels, where the capacity increases faster than the number of lines of traffic in the same direction on the same level.

The forward inflatable tube is at the centre of the last ring set at the end of the shove and supports that ring in circular form. As the clearance between the tail of the shield and the tunnel lining increases from nothing at the bottom to 2 in. at the top, the varying space between the lining and the shield has to be maintained in preserving in circular form the next ring to be erected. It is proposed to accomplish this by having a metal tube properly recessed into the tail on each side of the shield, occupying the middle quadrants and maintained by water pressure. These steel tubes would be in comparatively short sections and would be distended to correspond with the curve of the lining, thereby permitting of the ready erection of the lining in exact form and of holding it in place until the next shove brings the forward inflatable ring around it.

VOID BACK OF SHIELD TO BE FILLED BY GRAVEL SHOOTING

The drawings of the shield show spaces in

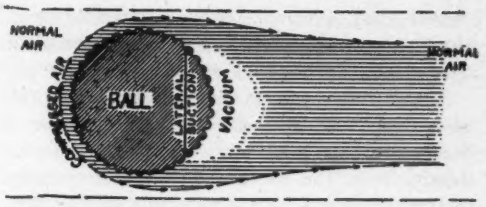
the skin between the jack circle and the end of the tail in which are rubber hose. Through these, gravel is blown to fill the space in the ground at the tail of the shield at the time the shield is being shoved forward. Experience has already shown that this gravel packs the space in the ground around the tunnel lining with great completeness and solidity. The gravel is ejected at a high velocity and the impact upon itself breaks the gravel into small particles with enough of its own dust to convert the broken gravel into a very dense embryo sandstone. This material, acquiring considerable hardness at once, holds the tunnel lining in place as set and maintains the surrounding ground in place without settlement or disturbance and in immediate connection with the lining, so that the ground and the lining sustain each other at once without movement of either. While the Pennsylvania R. R. tunnels were being driven across the Hudson River it was found necessary to use both braces and tie-rods to maintain the circular form of the cast-iron lining and these had to be retained in place for almost a year after the tunnel had been built, at the end of which time it was found that the ground had settled tightly around the lining with great uniformity of pressure so that the cast-iron tunnels retained their circular form unaided when the braces and tie-rods were removed to place the concrete lining.

This new method of filling with gravel the space in the ground between the lining and the walls of the excavation before either has had a chance to settle preserves the equilibrium of the ground undisturbed, and the same uniformity of pressures is obtained at once that in the case of unsupported ground required a year of settling to obtain by the restoration to the ground of its former equilibrium.

THE COMPRESSED AIR TAIL OF THE GOLF BALL

By P. A. Vaile

One frequently hears golfers and others asking the reason for the marking of the cover of the golf ball. The answer always is that the marking is necessary in order to make the ball fly straight. In other words the ball will not hold its flight unless it has some kind of a pattern on its cover; this has been proved beyond any possibility of argument; the smooth ball



has a most erratic flight, that, in fact, makes it useless to a golfer.

These phenomena have not, however, been explained by the scientists. It is a subject of much interest and of great practical importance to golfers so it is quite worthy of consideration and elucidation.

Nothing flies well without a tail. This might almost be laid down as a fundamental axiom in general aviation. As boys we have all seen the futile efforts of a sparrow to guide himself when minus his tail-feathers. A kite is useless without a tail. Where would the arrow go without its feather? The old round rifle bullet was a poor thing compared with the modern bullet that has got its "tail" in its *length and spin*, and an airplane without a tail would cut a sorry figure.

As it is with all of these so it is with the golf ball. It cannot fly well without a tail. It, in effect, has a tail, but it is invisible. That accounts for much of the mystery of the flight of the golf ball.

The golf ball leaves the face of the driver in a well hit stroke at a very great speed. It follows naturally that in front of the ball there is a cushion of compressed air. It follows just as naturally that immediately behind the ball there is something approximating to a vacuum. These are both clearly shown in the diagram. It will be clear that, from the front point of extreme compression to that point where the compressed air regains its normal density, there is a disturbance in the atmosphere in the form of a tube of compressed air, of varying density and containing a small vacuum.

As the ball travels forward it makes and, in a constantly decreasing degree, maintains this tube of compressed air. As this compressed air flows over the ball, if we may inversely express it in this manner, it spreads and runs between the excrescences on the ball.

The indentations thus get a grip, or take hold, of the air so that the ball is steadied in a remarkable degree during its flight and, although this is a point that has never even been

raised, the suctional action in lateral rear of the ball, probably also gets greater control on account of the marking of the ball.

It will thus be seen that, in effect, the golf ball has a "tail" of compressed air wherever it flies; that this tail is of varying degrees of density from the point of utmost compression in front of the ball until it regains normal density behind the ball, and that, on account of the lateral suctional action of the "tail" its influence persists until the point of normal density is reached.

We have now to consider the phenomenon of the erratic flight of the smooth ball. This has puzzled even a scientist so eminent as Prof. J. J. Thompson, Cavendish Professor of Physics at Cambridge University, England, and winner of the Noble Prize for Physics. Professor Thomson has admitted that he is unable to explain it, and, indeed, it is not easy to do so, but the explanation of the flight of the rough ball may help us in the consideration of that of the smooth sphere that is never used in practical golf.

The smooth ball cannot be relied on in any way. It ducks and soars and darts about sometimes almost as erratically as a butterfly. It would seem that the reason for this is, primarily, that its lack of grip prevents its "holding into its line." In other words the ball has a better chance of "slipping" its cushion of compressed air.

This probably is aided considerably by the defective center of gravity of the ball, a most common fault in most golf balls and a grave defect.

If the center of gravity of the ball is defective one side will lag more than the other and this will be seized on instantly by the compressed air to force the ball out of line. If the ball encounters, as it of course very frequently does, strata of air of varying density and also air pockets, these vagaries will be exaggerated; for the stream of compressed air is distributed thinly and, comparatively speaking, evenly over the surface of the smooth ball. It is then easier to break through than if the ball were, if we may so express it, in the grip of the "fingers" of compressed air that clutch the marked ball.

A consideration of these phenomena forces one to the conclusion that in the near future the marking of the golf ball by determinate indentations as in the ordinary "dimple" or "pit" markings will become obsolete. The bramble or pimple marking is now, if not actually obsolete, at least obsolescent, and in the opinion of many good judges it will soon be the same with all determinate markings, for they interfere with the "stream line" of compressed air and have no advantage whatever over the old marking by indeterminate grooves or sunken lines that ran right round the ball and allowed the compressed air to escape without unnecessary friction.—*Scientific American.*

VALUE OF COMPRESSED AIR IN ELECTRIC CENTRAL STATION CONSTRUCTION

For many applications pneumatic tools will now be found most economical in various forms of construction, for replacing manual labor and where costs and time have to be reduced. This applies to work indoors as well as outdoors.

Indoors, there are often concrete walls and floors, iron slabs, steel girders and re-enforcing to be cut through in running conduit, and so on, where considerable heavy labor is often required. The pneumatic drill and hammer for work of this kind will save time, and also money. So, too, outdoors, for cutting out sections of asphalt, opening up concrete sections of the road and cement slabs on the sidewalks, the compressed air drill may be used to advantage. It is particularly beneficial in cases where an important section of road has to be opened up during the night and be relaid before traffic begins next day.

Street railway companies and municipal contractors have employed pneumatic tools for various purposes quite largely. On the other hand, central station companies have not adopted it as largely as they might for their station construction and outside work. However, recently one central station company in Iowa used an air drill when laying conduit with very pleasing results. Instead of having to remove whole slabs of cement sidewalk, as had been necessary in the past, the air drill was used to cut a strip about a foot in width, thereby saving much time and reducing the expense. When using hand cutting the cost had been 40 cents per foot, but by using two drills and an electrical portable air compressor the cost was reduced to 18 cents per foot, the job also being prosecuted much more rapidly.—*Electrical Review.*

PNEUMATIC COAL PUNCHER

COMPRESSED AIR IN THE COAL MINE

By Charles A. Hirschberg

The mining of coal has developed to a point where it is quite generally conceded that the advantages of operation are all on the side of machine mining as compared with hand work. Machine mining quickens production, increases the capacity-to-produce of each man unit, making it possible either to expand coal mining operations or to release miners for other portions of the work as occasion requires. The labor problem has affected the coal mining industry the same as every other industry and the present acute shortage makes the superiority of machine mining especially pronounced.

As is the case with every other industry, there are several classes of machinery from which the coal operator can choose, and the problem, therefore, becomes one of selecting that type and make of equipment which will produce coal in quantity with greatest economy and efficiency.

In the early days of coal mining the miner with pick, shovel and hand auger played a vital part. Then followed the introduction of compressed air-operated machines and new methods of mining which were a decided improvement over hand work.

Latterly, as the application of electric power spread throughout every industry, mining machines driven by motor were introduced, partially replacing compressed air equipment for certain classes of work.

Of late the methods of coal mine operation have undergone still further changes, as a result of which compressed air has resumed an important place for certain phases of the work. There is no intention to deny electricity any of its just dues, for it is performing admirably in coal mining. Nevertheless current practice shows three distinct classifications of coal mines, namely; the compressed air operated mine, the electrically operated mine and the mine which utilizes a combination of the two. In the discussion which follows, no attempt will be made to tell the story of the electrically operated mine, but will be confined to a discussion of the methods and advantages of employing compressed air, either exclusively or in combination with electricity.

Coal mining logically divides itself into two divisions of work; development and production. The chart herewith shows the range of work and the application of air tools.

DEVELOPMENT WORK

The problems involved in sinking shafts and driving development tunnels do not differ from those of contract or metal mine work of similar nature. The same methods are pur-

DEVELOPMENT	Shaft Sinking	Unmounted Rock Drills		
	Tunnel Driving	Mounted Rock Drills Unmounted Rock Drills		
	Entry Driving	Unmounted Rock Drills		
	Drainage	Ditching Sump Digging	Unmounted Rock Drills	
	Haulage Installation	Track Ballasting	Pneumatic Tampers	
		Hanger Hole Drilling	Unmounted Rock Drills	
	Stripping	Unmounted Rock Drills		
PRODUCTION	Thick Seam Mining	Undercutting	Flat Seams	Air Punchers Air Chain Cutters
		Overcutting	Pitching Seams	Mounted Radial Punchers
		Shearing	Mounted Radial Punchers	
		Shot Hole Boring	Air Auger Drills	
	Thin Seam Mining	Undercutting	Mounted Radial Punchers	
		Shot Hole Boring	Air Auger Drills	
	Open Pit Mining	Unmounted Rock Drills or Air Augers		
	Haulage	Air Locomotives Air Hoists		

COAL MINING OPERATIONS AND MECHANICAL EQUIPMENT

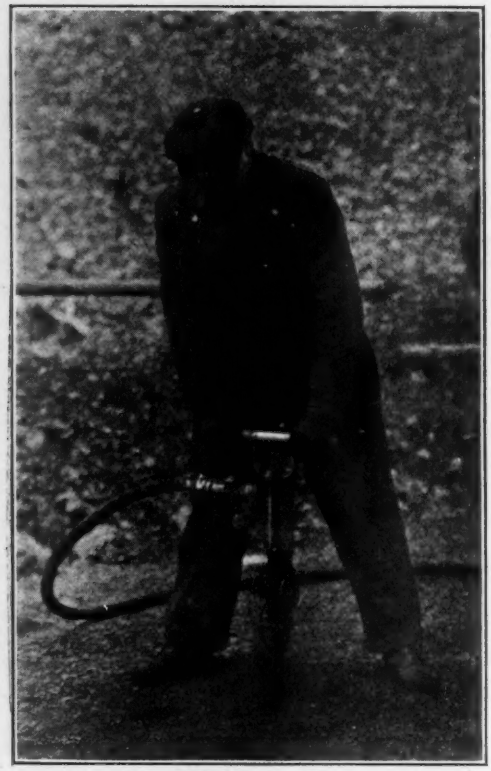


FIG. 1. JACKHAMER DRILLING COAL BED

sued and the same classes of machines used. Everyone will concede that for this class of work—rock drilling and excavation—compressed air is unrivaled. The work is of rough character and none but the most rugged machinery is capable of standing up to the work.

Fig. 1 shows the unmounted type of drill employed for down-hole drilling, such as shaft sinking and bench work. It has, on occasion, been mounted for light heading work.

An estimate of the capacity of the mounted drill may be gained from a performance record on a development tunnel at Shenandoah, Pa., where 513 feet of 12x7½-foot tunnel, carrying a 4x2-foot drainage ditch, was driven in 28 days, working three 8-hour shifts per day.

At one of the D., L. & W. mines, where a shaft sinking job was in progress, an unmounted drill, in this case a "Jackhamer," was observed to have put in a total of 4,760 feet of drill hole in 17 days' working.

At a Tennessee mine a 7x14-foot shaft was sunk 24½ feet in six days, working two 9-hour shifts per day. Six drills were employed, drilling a round of thirty-six 5-foot holes.

The drill shown in Fig. 1 has also found a wide application in driving entries, almost entirely supplanting the mounted rock drill for this purpose. It has been found more suitable due to its lightness, its ready movability and its ability to work in restricted quarters. It is also employed to a considerable extent in track work, leveling the track bed, drilling trolley hanger poles and trimming roofs.

There comes from Kentucky an interesting comparison of the time required for drilling trolley hanger holes. Two men with hammer and steel were taking a whole day to drill 9 or 10 holes from 4 to 6 inches deep when by the use of a "Jackhamer" it was found that one man could do an equal amount of work in from 10 to 15 minutes.

TRACK WORK

In the Lake Superior region among the iron and copper mines, the problem of track installation and maintenance has been met by the adaption of pneumatic track equipment. They have profited by the experience of the steam railroads. The use of the track tamper in track work has resulted in a considerable saving in labor and cost in track maintenance,

FIG. 2. SHAFT SINKING WITH JACKHAMER

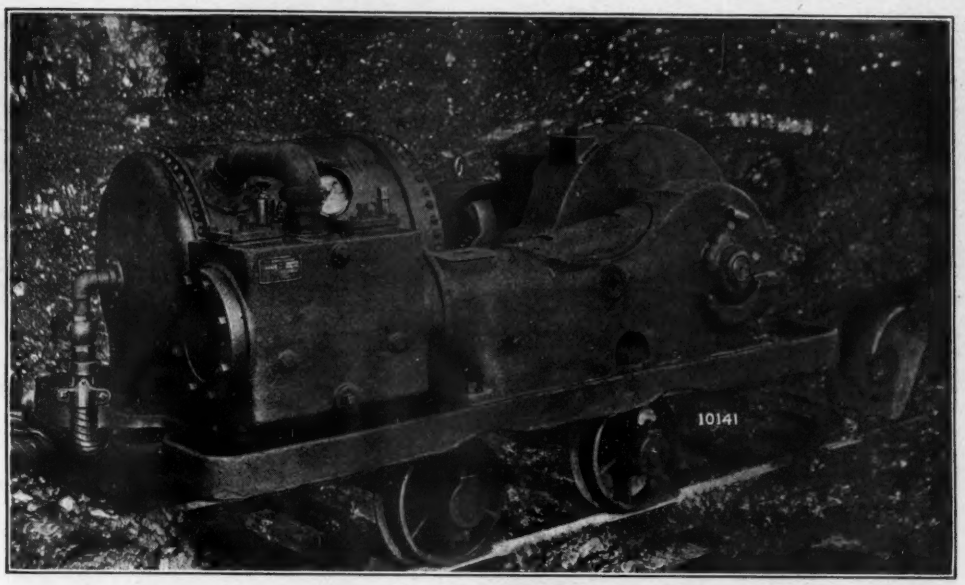


FIG. 3. A MINE CAR COMPRESSOR

and inasmuch as the track problem in coal mines is not dissimilar to other mine track work, the pneumatic tamper should prove of service to the coal operator.

Having the pneumatic tamper, there are other uses to which the coal mine can adapt it. During the recent cold spell these tools were employed on the docks and coal dumps at shipping points for breaking up the frozen masses of coal in hopper-bottom cars for reloading into barges, etc. For this kind of work a pointed pick was used in place of the usual tamping bar.

THE CAR-MOUNTED COMPRESSOR

For mining and handling coal underground, in electrified mines which are not piped with air, compressed air equipment has been made available by the introduction of portable mine car mounted, small compressor units. The mine car compressor is comparatively a recent development in the application of compressed air to modern coal mine operation, and bids fair to grow in favor as its advantages are better appreciated. An outfit of this kind is capable of rendering remarkably consistent service with but little expert attendance, due primarily to its dirtproof construction, self-lubrication and automatic control. Ordinarily the compressor is operated close enough to the face to obviate the need for even semi-permanent piping—a hose connects it to the tools. While compressor units of this kind have undoubted advantages in an already electrically equipped mine, it would not be advisable under ordinary circumstances, to install electricity for the purpose of operating them. Greater economy would undoubtedly be obtained by the erection of an above-ground compressor plant, with a modern Corliss or piston-valve steam-driven machine, and boiler equipment to utilize coal as fuel.

These mine car compressors are usually employed in operating pneumatic coal picks and pneumatic augers for boring shot holes, breaking down coal, and to some extent in picking out dirt and slate bands. In general, the tool is of the "Jackhamer" type and is used as a hand drill, being held and guided by the miner. Originally introduced into coal mines for shaft work and rock drilling in entries, tunnels, etc., these little machines have since developed applications which connect them more intimately with the actual production of coal, as already mentioned above. In drilling rock they require a hollow hexagon drill steel, but for work in coal it is usual to employ a twisted cruciform steel of the coal-auger type.

The amount and varied character of work which they are capable of doing is best exemplified by brief citations of actual work done.

At one West Virginia mine two "Jackham-

ers" (one in use 9½ months, the other three months previous to the time of writing) are reported to have driven 11,460 feet of narrow entry, 7,868 feet of entry 10 feet wide, 3,292 feet of 12-foot entry and 3,000 feet of 22-foot entry, slate on the whole work averaging about 6 feet in thickness. In addition, four overcasts of a total area of 331 square feet have been made, two waterways 50 feet long by 2½ feet square have been driven, a ditch 125 feet long, 18 inches wide and 3 feet deep has been dug, and a pump room 9x12x18 feet cut in solid rock.

drilling boulders and cap rock for blasting preparatory to shovel loading and further for drilling the coal bed.

The experience of a Texas mine in boring in a 30 to 40-inch seam of semi-bituminous coal is an excellent example of the comparative working speed of hand augers and a "Jackhamer" drill. By the former method four men using a post auger consumed five hours in drilling four 4-foot holes, while with the air drill two men did the work in about 25 minutes. At this mine the working space is very low and the men must kneel.

FIG. 4. BORING HOLE IN THIN SEAM WITH JACKHAMER

In a Kentucky mine these drills are spoken of as having proven "most useful" in drilling the fine grain, hard sandstone roof above the coal. Mention is also made of their use for "shooting sumps, taking bottom, and drilling hanger holes."

In a Washington mine two "Jackhamers" were recorded as having driven 2,000 feet of rock tunnel and 1,700 feet of gangway in coal, including the lifting of bottom rock, and were expected to shortly complete a second 3,000-foot rock tunnel.

In stripping operations, such as are being carried on in the Kansas and Illinois districts, drills of this type are extensively used either with a portable compressor or as an adjunct to the steam shovel and operating on steam direct from its boiler. The duty consists in

"Jackhamers" and the portable mine car compressors already described form a combination equipment that has won favorable comment in many mines for its ability to bore shot holes in coal most economically. The measure of their superiority over other methods is well exemplified by the fact that one single company has placed some 30 odd compressor units in its mines.

In the work mentioned in the foregoing paragraphs the drills were used without mountings, being held and guided by the workmen. There are, however, recently developed mountings whcih relieve the miner of considerable muscular effort and at the same time facilitate the work. For rock tunneling it is possible to equip a "Jackhamer" with a detachable feed-shell mounting which makes it then

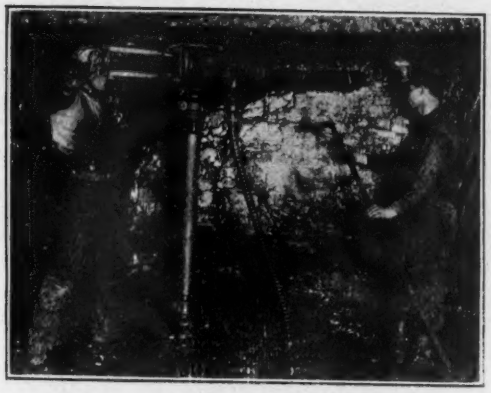


FIG. 5. OVERCUTTING WITH RADIALAXE

adaptable to use as a column mounted drill. This type of mounting has found wide favor among the metal mines and will undoubtedly be employed in future coal mine tunnel and rock drilling development work.

The second mounting (Fig. 4) accommodates the "Jackhamer" when fitted for boring coal, and was originated to meet the demand for a means of mining thin seam coal. The successful method is entirely one of boring and blasting, the slight extra expense for powder being more than absorbed in the time and labor saving as compared with other mining methods. In narrow workings of this kind a mounting, such as shown in Fig. 3, relieves the miner of the need for effort other than that of pushing the drill forward on the slide rails. The four legs are provided with extension pieces which permit adjustment of the mounting for drilling holes at any needed angle. In operating with this mounting the drill is clamped in a light cradle to give a bearing on the slide rails.

This type of mounting has proven of great assistance to operators in speeding up work, and it is expected that it will be adapted to work in high as well as narrow seams.

Compressed air-driven mining machines are inherently sturdy, simple, abuse-proof, and in consequence maintain their initial efficiency despite the handicap of unfavorable working conditions and unconsciously careless handling. It is perhaps for this reason that the employment of one of the earliest type of coal mining machines, namely, the coal puncher, still persists in a great many coal mines for the work of undercutting. Its one limitation is that it is only applicable in flat or slightly pitching seams, in which the angle of pitch does not exceed 25 deg.

THE RADIALAXE

For such work as undercutting and overcutting shearing in more sharply pitching and narrow seams the post machine similar to the Radialaxe (Figs. 5 and 6) has proven the only practical means of machine mining such coal formations. The machine is of the reciprocating puncher type, and is mounted on a short column equipped with means for swinging it in an arc in any plane from horizontal to vertical.

It has proven very successful in coal formations, regardless of thickness, for the work of cutting out bands of dirt, clay, etc. As instances of typical performance it is interesting to note the following: In one Canadian mine, the coal bed is 6 feet high and almost level. The rooms average about 20 feet wide, and these are undercut by Radialaxe machines to the full depth of 5 feet 6 inches, or 6 feet, and the coal blown down by the three-hole system. One hole is placed about the center of the room, about 4 feet from the floor of the mine, and is known as the plug hole. A hole is then drilled out of each corner of the room, about a foot from the side or rib, and a foot from the roof. The center or plug hole is blown first, then the two corner holes are blown together.

The output per machine will vary all the way from 5 to 10 rooms, depending on local conditions of roof, floor and the existence of sulphur balls, and on the ability of the op-

FIG. 6. SHEARING WITH RADIALAXE

erator. Down there, the coal is all cut by contract, the machine runner getting so much a ton and paying his own helper. It is rather difficult to get at the maximum capacity of the machines owing to this fact. That is to say, the machine runner makes anywhere from $8 to $15 per day clear of expenses, and when he has made what he considers enough for one day, he quits and goes home. If he has good luck and good air pressure, he may get his 10 rooms out in five or six hours, when he is free to go home.

In a test performance, one Radialaxe cut 84 rooms, 30 feet wide in 16 shifts.

At an Albama mine a 3-foot coal seam was undercut at a rate of 280 square feet in 4½ hours, including all moving time. On the basis of a ton per cubic yard this amounts to a production figure of 60 tons per nine-hour shift.

In Southern Illinois under high coal and in level veins the Radialaxe will undercut two 25-rooms to a depth of 6 feet, or will shear about four places 10x7 feet.

At another mine one man established a record of undercutting ten 20-foot rooms to a depth of 6 feet in an eight-hour shift. Coal in this seam pitches about 16 to 20 deg. and is 6 feet 4 inches in thickness.

A Radialaxe operator was timed at one of the Canadian mines and the following figures recorded: 21 minutes were required to make a 6-foot undercut 14 feet wide. The initial set-up of the machine required just five minutes.

In cutting out an 8 to 10-inch band of dirt in the center of the coal seam in a Tennessee mine 60 square feet of cut was accomplished in one hour and a half. The cut was made at the bottom of the band, removing all but 3 inches of the dirt, and as soon as the cut was made this remaining dirt fell in, leaving the coal practically clear.

COMPRESSED AIR LOCOMOTIVES

The same conditions which necessitate the use of air mining machinery make it expedient to utilize the compressed air locomotive for gathering and haulage work. In actual work done the compressed air locomotive compares favorably with other methods of haulage, in convenience, efficiency and economy. Its outstanding virtue is the entire absence of the fire hazard and that of danger from electric shock as well as the avoidance of creating disagreeable exhaust gases. The air locomotive is self-contained and after the laying of track there is no supplementary wiring or rail bonding to be done; a particular advantage when the trackage is at best only temporarily needed. The modern air locomotive uses air expansively, in two stages. Manufacturers of these machines state that except under unusual conditions the cost of power to operate is no greater than that required for electric types.

As an instance of the economy which obtains with air haulage as compared with horses, the following figures are quoted, taken from a paper by Raoul Green delivered before the Canadian Mining Institute, in 1916.

The observation was made in a mine working under the following conditions: seams pitching 25 deg. or more; pit cars containing two to three tons; rails weighing 30 to 40 pounds per yard; grades fluctuating but little from 0.46 to 1.00 per cent in favor of the loads; gangways roomy; tracks fairly well kept; curves few and slight.

	Compressed air	Horses
Labor	$0.046	$0.072
Supplies	0.017	0.022
Depreciation	0.015	0.015
Total cost per ton-mile..	$0.078	$0.109

In recent years an air-operated type of hoist has been developed, which is being used extensively for the work of hoisting and lowering timbers, hauling cars in gangways and up and down inclines; in general, replacing hand power for light work. This hoist can be attached to any convenient means of support, such as a column, bar, pipe, timber, etc.

The surface compressor plant which supplies air to underground mining equipment also furnishes power to such shop equipment as drill sharpening and grinding machines, pneumatic drills, wood borers and riveting hammers and the like.

The machine drill sharpener with its auxiliaries, the shank and bit punch for hollow steel, and the shank end grinder play an important part in maintaining the drilling equipment at a point of high efficiency. This is especially important in the case of rock drills, as the absolute perfection of each drill bit is a necessity if lost time is to be avoided in the work of rock cutting. Improperly sharpened

or imperfect drill bits handicap the most powerful drill and cause steels to wear excessively and often to stick in the hole.

A machine drill sharpener at a Nevada mine, operated by one blacksmith and a helper, turned out an average of 84⅓ resharpened bits per hour over a two months' working period at a total cost of 1.709 cents per bit. This alone is conclusive evidence that hand drill sharpening by comparison is too costly to be permitted, under present conditions, at any mine.

In closing, it is well to note that compressed air is a safe power. There is an entire absence from danger of fire or possible gas explosion, and in time of danger from other sources it is capable of giving valuable assistance. Air pipes may be used as water carriers for flooding purposes in cases of fire, as messengers and food transmitters in case of caveins and as a means of ventilation. In this latter respect, it will be found that the exhaust from compressed air tools has a salutary effect upon the ventilation of the mine.—*The Coal Industry.*

A NEW GAS FOR WELDING AND CUTTING

A gas that is used for welding and cutting, in the same manner as acetylene, is acetylene enriched with the heated vapors of crude oil. The special feature in its production is the use of cartridges of material, consisting of alternate layers of calcium carbide and sawdust soaked in oil. It is necessary to wash, purify and cool the gas, which is generated automatically in a portable apparatus, as needed, and delivered to the torch at 15 pounds pressure.

It is well known that the volume of lime into which the calcium carbide is converted by the slacking process is greater than the volume of the carbide. Therefore, when carbide is packed tightly in cartridges, as desirable, the expansion is likely to burst the case and in some cases it might cause the cartridge to jam in the chamber, as well as interfere with the successful working. One of the objects, then, is to make the cartridge so as to allow for the expansion of the contents. Another, is to prevent the oil from coming in contact with the carbide, as this would interfere with the action and decrease the gas output.

The cartridge consists of a tin can of suitable size, the smallest being 4⅜ inches in diameter and 8 inches high, weighing 6 pounds and having a gas producing capacity of 25 cubic feet; the largest 9¾ inches in diameter and 16 inches high weighing 40 pounds. A cylindrical screen is first placed in the can to be filled and then a layer of carbide is placed in the bottom of the can around the screen tube. An unglazed cardboard disc is next placed on top of the carbide. A space, made of thin metal bent so as to lie edgewise, is placed on top of the cardboard and then a disc of screen is put over it. Sawdust in a cloth sack, impregnated with crude oil, is laid on the screen, then a space and a cardboard disc and so on to the top, ending with a sack of oil-soaked sawdust covered with a piece of screen that has no hole in the center for the cylindrical tube. The end of the can is closed with a cover for handling, which is removed before placing the can in a generator.

The water, feeding in through the valve in the cartridge chamber, dips down through the cylindrical screen tube and starts slacking of the cover layer of carbide, the heat of which vaporizes the oil in the sack above it. The cardboard discs, while strong enough to hold the layers firmly in place while dry, begin to soak up as soon as the feeding starts and consequently become soft so as to give way under the pressure of the expanding carbide, allowing it to be forced into the spacing between the carbide and the oily sawdust. Steam or water vapor must pass through the absorbent cardboard as well as the oil before it reaches the next layer of carbide. Action of the steam on the carbide above is thus prevented. This insures that the respective layers of carbide will not be acted upon until the water becomes level with them in turn. In consequence a cartridge can remain in a generator a long time without being spent. The screen discs in top and bottom of each layer of oily sawdust furnish efficient volatilization and egress of the gas.

There are several claims made for this new gas. It is heavier than air, and it is said it can be used at a lower pressure, slightly over 1,400 pounds, and at the ordinary atmospheric temperature; but it is not explosive when liquefied. The explosive ratio is from 12 per cent. to 30 per cent. air. An excess of

oxygen is not required in the welding flame, so that there need not be any reduction of the carbon in the iron or steel which is being welded, thus producing a soft weld.—*Scientific Amercian.*

The tool shown in the half-tone is the Little David calking machine now being put on the market by the Ingersoll-Rand Company. It is entirely beyond the experimental stage and is an assured success wherever introduced.

THE OLD WAY AND THE NEW WAY OF CALKING

A CALKING MACHINE TO SPEED UP SHIPBUILDING

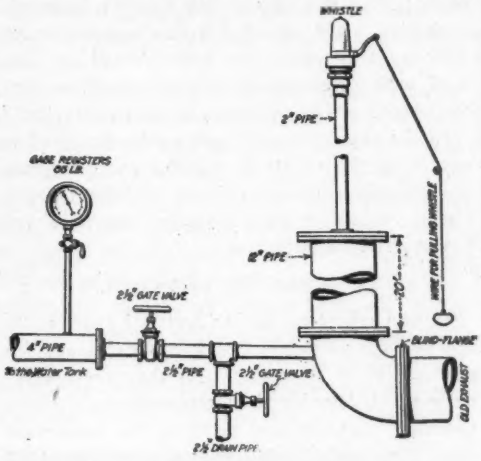
American shipbuilders will be specially interested in learning of the perfecting of a practical pneumatic caulking machine. The tool here shown should greatly accelerate the speed of wooden shipbuilding, which up to now has been hindered by the scarcity of competent calkers. It goes without saying in these times that any device which will speed up shipbuilding, or, for that matter, any war industry, is at once to be not only welcomed but put to work to the full extent of existing opportunities.

The machine weighs but 13½ lb. and performances critically observed have shown that it can be easily handled and operated in any position. It automatically tacks either machine or hand-spun oakum in side or bottom seams to any depth required for final horsing. On deck planking it will also do the horsing. Its working speed is about 1500 tacks per minute either coiling or running the oakum straight.

The Little David calking machine is controlled by a trigger similar to that of a light scaling hammer. It differs, however, from the usual hammer in that the piston has an extended rod fitted with a thin calking blade. This,

being a reciprocating iron with positive pull-back, has no tendency to bind. The calking iron travels in guides which prevent it from turning, the whole being fitted with springs so that the workman can vary the penetration of the iron with the varying depth of the seam. A unique device automatically feeds the oakum with each movement of the calking blade. Guide wheels run in the seam being calked and keep the threading iron lined up. The tool operates with negligible vibration, and it follows without effort on the part of the workman; in fact, machine calking is made so simple that ordinary workmen can do highly efficient work. The tool measures 22 inches in length over all. The ordinary equipment consists of a calking iron 1/16 in. thick, although an ⅛ in. iron can be furnished if required.

A demonstration was recently conducted before the U. S. Shipping Board Emergency Fleet Corporation and the tool was approved.



A WATER WHISTLE

By Frank Huskinson

Central station power was installed at a certain mine. The power house was converted into a substation. As there was no necessity for keeping up steam, the use of the boilers and engines was discontinued. Then it was discovered that the steam whistle which had signaled the time of starting and stopping work could not be sounded. I decided to try a scheme of blowing the whistle by means of water and air. The water tank was located upon a hill. The pressure at the boiler house was 85 lb., and we had plenty of water.

Part of the old exhaust line from the engines consisted of a 20-ft. length of 12-in. pipe which extended vertically from the floor up through the roof of the boiler house. I removed the exhaust head from this piece of pipe and put on a special flange that reduced the 12-in. pipe to a 2-in. opening. Then I took a piece of 2-in. pipe 18 ft. long and secured the old steam whistle to one end of it. The other end I screwed into the opening on top of the 12-in. pipe.

On the bottom part of the 12-in. pipe I put in a blind flange. I also made a connection in the 12-in. pipe for a 2½-in. pipe. Into this opening I screwed a short piece of pipe. Onto this I screwed a tee, then another short piece of pipe and a gate valve. This was connected to the 4-in. water line from the tank. The outlet of the tee was then fitted with a short piece of pipe and a gate valve from which a section of pipe was run outside the building as a drain.

The accompanying diagram shows the details of the pipe connections and whistle. All joints were made air-tight. The whistle was of a type that is operated by means of a quick-acting valve. This was opened by pulling a wire. The operation of the "water whistle," as it was called, was simple and quite satisfactory.

The valve for draining the 12-in. pipe was opened, also the whistle valve on top was held open, and all the water was allowed to drain out. Then the whistle valve and the drain valve were closed, and the valve on the water line was opened wide, allowing the water to flow into the 12-in. pipe. This was done about 30 sec. before the whistle was to be blown. Next the wire that opened the whistle valve was pulled, allowing the whistle to blow.

The action of the apparatus was as follows: The draining of the 12-in. pipe with the whistle valve open allowed the pipes to fill with air at the ordinary atmospheric pressure. As soon as water from the main was turned into the pipes, all other outlets being closed and air-tight, the air inside the pipes was compressed to the pressure of the water, which is 85 lb. As soon as the whistle valve was opened the air that rushed through the whistle had almost as much effect on it as had the steam used formerly. The water entering the pipe kept the pressure almost constant, and the whistle could be blown for several seconds or for

short blasts. After each blowing of the whistle it was necessary to drain off the water from the 12-in. pipe, as described in the preceding paragraph, and this being done at once the whistle was always ready for use.—*Coal Age.*

THE MAGNITUDE OF THE TRENCH GAS PROBLEM

While the daily press has kept us perhaps sufficiently informed of the fact that poisonous gases are now employed as weapons of kultured warfare few of us have realized their deadly efficiency or the extent to which they are being employed. At a recent meeting of the Chicago section of the American Chemical Society Major S. J. M. Auld, chemical adviser of the British Military Mission thrilled the audience for nearly two hours with his description of the havocs of gas in twentieth century warfare. He described the first gas attack made by the Germans early in the war and the gallant resistance of the heroic men who met it without even the most primitive means of defense. He proceeded to tell about the development of the gas offensive from the first gas-cloud attack with chlorine to the use of phosgene, various tear and sneeze-producing gases, poison gases, and finally the latest accomplishments with gas shells. The great magnitude with which some of these attacks were carried on may be impressed upon us by learning that hundreds of tons of liquid chlorine have been used in a single attack, and that in some cases the drums of chlorine were placed so closely together that there were three for each two yards along a front of considerable length. The effect of weather conditions, the direction and velocity of the wind, the factor of safety, and many other details were explained.

In recent attacks with gas shells, as many as 35,000 to 50,000 shells have been dropped on a limited acreage in two or three hours. Some of the gas shells contained, in addition to the bursting charge of high explosive, bottles containing liquid, and in some cases even solid chemicals, which would be so completely atomized by the bursting of the shell that they would have the same effects as shells charged with liquefied gases. It was stated that a case was on record in which a shell which failed to explode was examined and found to contain bottles with the orginal Kahlbaum labels still intact.

Passing to the defensive, the speaker described the development of the gas mask from a simple cloth bandage soaked in various chemicals to the elaborate mask which is now in universal use. As fast as the enemy introduced new devices for gas offense a suitable defense was provided to overcome it. The experience was bitter and costly, but at the present time the idea is prevalent that the worst is over, and that the defense is, in general, developed to a greater degree of efficiency than the offense.

It was very gratifying to hear him say that the mask produced by the Americans, and now in general use at the front, was considered superior to any of the others. Not only are the men provided with masks, but even the horses, mules and carrier pigeons are provided for. In the case of the horses and mules, as these animals breathe through the nose, a mask made of cloth soaked in chemicals is drawn over the nostrils. In the case of the pigeons, however, each bird is not provided with a separate mask. The cages in which they are confined are covered with preparations which prevent any of the objectionable gases reaching the interior.

In the composition of gas masks designed to neutralize the effects of chlorine and phosgene, the chemicals most used are sodium thiosulphate, sodium phenate, activated charcoal, and hexamethylene-tetramine.

SHOVELING THE GASES OUT.

In our report of Major Auld's lecture nothing appears as to the operations necessary for getting rid of the gases. As they are specifically much heavier than atmospheric air they naturally seek out and settle in the lower levels. The gas clouds penetrate trenches and deep dugouts, and in most cases it is a matter of many hours before they become sufficiently diluted with the atmosphere to permit of safe breathing. So the matter resolves itself into a problem of driving the poisonous fumes out of the trenches and underground shelters, or at least thinning them out until the air is again made safe. And this is done in the most common sensible way in the world. The gases are simply shoveled out, and actual photos of the operation have been exhibited. The broadest scoop-shovels are employed and to these are added wings or flappers at the sides. Men employed in this work of course use respirators and are relieved at frequent intervals.

FIG. 1. AIR COOLING PIPES

COMPRESSED AIR INCREASING PRODUCTION OF OIL WELLS

What follows is abstracted from Bulletin 148, Petroleum Technology 37, of the Bureau of Mines. What is known as the Smith-Dunn process, first employed near Marietta, Ohio, for stimulating the production from oil wells by forcing air through the oil sand, is known to have been employed on over 90 properties, of which at least 80 per cent have been successful.

The essential principle of the Smith-Dunn or Marietta process is to replace the natural gas, which originally accompanied the oil and was the principal agent in forcing the oil into the wells but has been exhausted, with compressed air. The air is forced into the sand under pressures varying from 40 to 300 pounds through some of the wells on the property, which are called "air wells," the oil being pumped from the other wells in the usual way. Any gas which does not combine with the oil chemically under the conditions existing underground could be used, but of these gases only air and natural gas are practically available. On the old, nearly exhausted properties where the process has been employed natural gas is seldom available, or only at excessive costs, and it is seldom practicable to us anything but air.

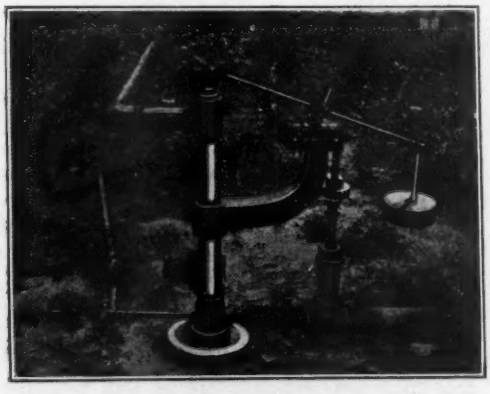


FIG. 2. OIL PUMP RUN BY AIR

EQUIPMENT REQUIRED

The extra equipment necessary for using the process over that commonly used on any producing oil lease consists of an air-compressor plant, a system of piping for conveying the compressed air to the air wells, and the preparation of certain wells for taking air.

The air compressor can be of any efficient type, and is usually driven by a gas engine, because gas is in nearly every instance the cheapest and most available fuel. However,

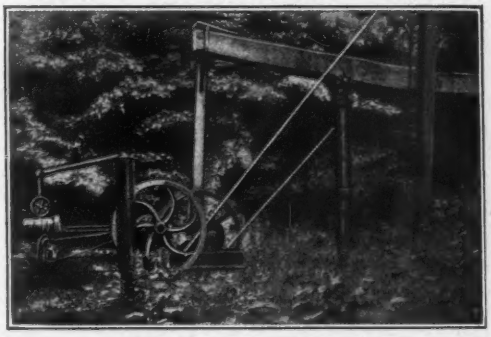


FIG. 3. BEAM PUMP AIR DRUM

any other type of engine can be employed. The tendency has been toward using direct-driven types because of greater efficiency and compactness.

The compressors in use vary in size from 20 to 100 horsepower. It is considered advisable to restrict the size of the units to 100 horsepower, and where more power is needed to install additional units. Where the air is compressed to a pressure of more than 100 pounds, two-stage compressors are generally used.

The compressed air is distributed through 2-inch to 4-inch mains, with 1-inch laterals leading to the air wells. With the distances and the velocities of air used on the ordinary plant, these sizes are large enough and the pressure losses due to friction do not warrant the extra cost of increasing the size of the pipe. The air should be conducted through a cooling system near the compressor Fig. 1, and the water drained off in taps, otherwise

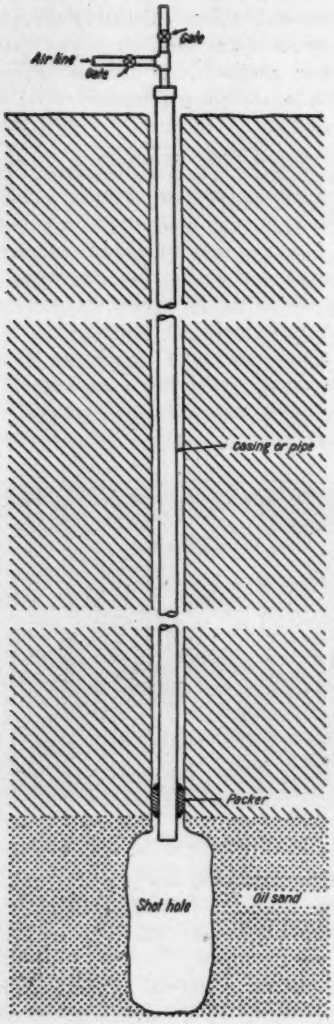


FIG. 4

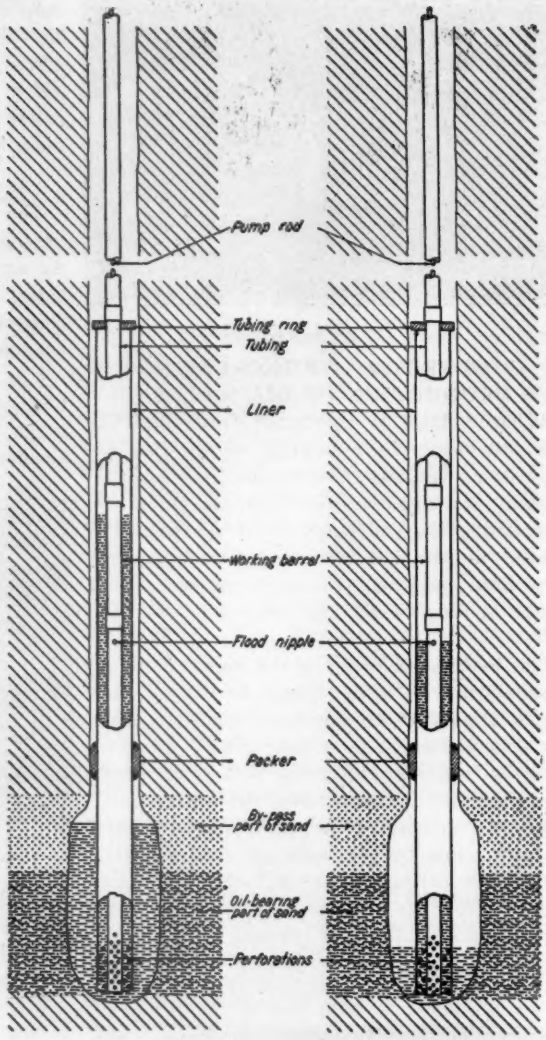


FIG. 6.

it will give trouble in the lines, especially in winter.

It is also necessary to have a gas-gathering system from the pumping wells to supply fuel for the compressor plant. These usually consist of 2-inch lines, and the system is essentially the same as on the ordinary lease where casing-head gas is used for fuel or for making gasoline.

The well-pumping equipment can be of the usual kinds, but as the compressed air can be used as a source of power there has been a tendency to put in pumps operated by compressed air. Figs. 2 and 3 show types of such pumping equipment.

The oil-gathering equipments are of the usual kinds, and the only effect that the use of compressed air has is to reduce the number of pumping wells, and therefore the amount of such equipment necessary.

The essential equipment in an air well consists of 1-inch or 2-inch piping or tubing which extends down to the top of the oil sand and is packed or cemented directly above the sand (see Fig. 4). If the well is cased directly above the sand the air may be intro-

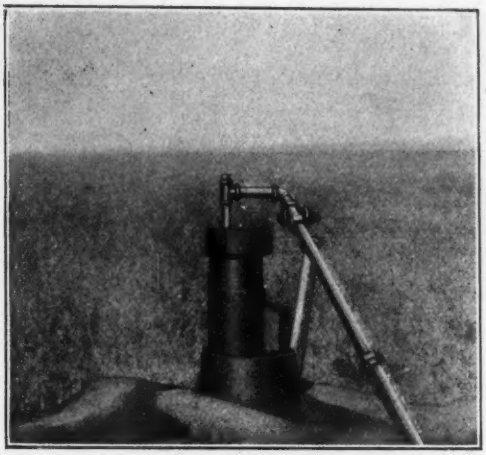


FIG. 5. WELL PIPED FOR AIR

duced through the casing (see Fig. 5). Where the pumping wells are fitted to take back pressure it is necessary that provision be taken, as in air wells, to prevent the waste of air, and, in fact, the possibility of leakage should be carefully considered at all points in the system because leaks in the air lines or the diffusion of the air into unprotected formations through air wells, pumping wells, or old abandoned wells will greatly reduce the efficiency of the method. The same can be said of the pumping equipment, and steps should be taken to prevent the unnecessary escape of air from pumping wells.

PREPARING AIR WELLS

One of the most important considerations in preparing wells for taking air is to not let the air have access to any formations other than the oil sands, otherwise large quantities of air may escape into the barren strata and be wasted. If the well has a string of casing tightly seated on the top of the oil sand, the air can be let into the top of the casing through a tight head or cap (see Fig. 5). When the well is not cased in this manner, a string of small pipe or tubing is placed in the well and packed at the top of the sand, as shown in Fig. 4. One inch pipe has been used in shallow fields, this sometimes being the only pipe in the hole.

It has not often been considered necessary to shoot the air wells. They should, however, be cleaned out, and sometimes it is advisable to remove the waxy sediments that clog the surface of the sand. Newly drilled wells have the advantage of the sand being perfectly clean and free from waxy sediment. Occasionally a combination well is made by forcing the air down between the casing and tubing in a pumping well. Such a well can be used as an air well for a time and then be pumped when the air is stopped and the oil comes back under the released pressure.

PREPARING PUMPING WELLS

In preparing the wells on a property for the use of compressed air, ordinarily no changes need be made in a pumping equipment unless it is old and out of repair. However, the process is frequently installed on properties where the equipment has been allowed to run down because the small profits have not permitted repairs and replacements.

It is sometimes desirable to maintain back pressures in the pumping wells on the oil sand. There are several ways of preparing a well for the use of regulated back pressure, the simplest being to place a reducing valve on the gas-gathering line from the casing head. When pressure is maintained in the well by this

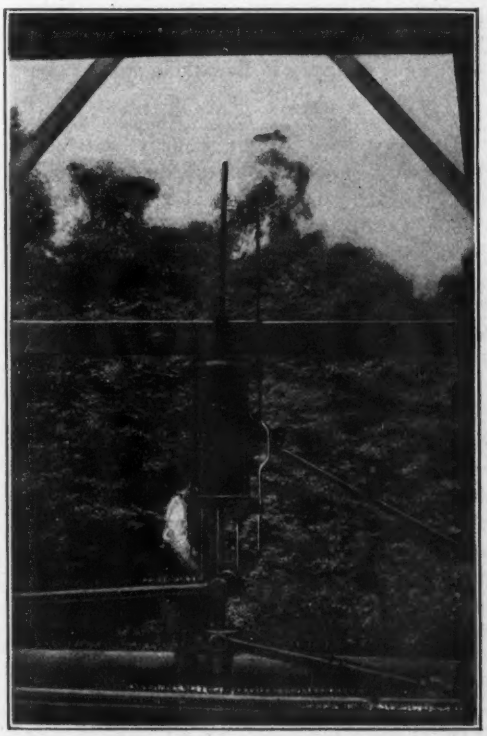


FIG. 7. PUMP HEAD RUN BY AIR

means, the formations overlying the oil sand should be cased off so that the gas will not waste in the same way as it would in an air well not cased off. Another method for maintaining back pressures in the wells is shown in Fig. 6.

Although the process does not require changing the type of pumping equipment, a logical development will be a greater use of compressed air in the future as the source of pumping power on leases employing the process. The power is centralized, and the air is readily distributed without much loss in power or trouble in operation. In many eastern fields the wells were pumped by compressed air long before the process of forcing compressed air into the sands came into use.

At Bradford, Pa., the compressed air is also used to run steam engines, pumping wells "on the beam" or in "air heads." Air lifts have been tried in the eastern fields, but were never satisfactory. Smith and Dunn use air displacement pumps on many of the shallow wells where their process is employed. On a few of the properties some of the wells have displayed a tendency to flow; and it is possible that with the proper application of the air the wells can sometimes be made to flow their productions.

PROPORTION OF AIR WELLS

The proportion of air wells to producing wells will depend not only on the local conditions on each property, but also on the principle on which the process is being operated. If back pressures are being used, different factors enter into the problem from these more pertinent if no back pressures are being maintained. Experience without the use of back pressure indicates that the best practice is to distribute many air wells as uniformly as possible among the producing well. More recent experience with the use of regulated back pressures indicates that fewer air wells are necessary, and that the wells so used can be chosen by their capacity for taking air rather than because of their central location among a group of producing wells. Where back pressures have not been used the tendency has been to increase the proportion of air wells, the average among 34 properties tabulated being 1 air well to 2.6 producing wells. At first consideration the operator is apt to think that as few air wells as possible should be used, but experience has shown otherwise.

SMALL PORTION OF CAMP GRANT

AIR LIFT PLANT AT CAMP GRANT

The following we abstract from an interesting paper by Chas. B. Burdick in the Journal of the Western Society of Engineers.

Camp Grant, at the junction of Rock and Kishwaukee Rivers, five miles below the center of Rockford, Illinois, comprises 5,620 acres, or about 9 square miles. The larger part of the reservation is devoted to the rifle range and maneuvering ground. The camp proper provides quarters for 42,000 men and 10,000 animals. There is a total of 1,520 buildings, all of modern construction, ranging in size from 60 ft. by 160 ft. down to about 14 ft. square. The greater number of buildings are the company barracks, which are two-story structures 43 ft. by 140 ft.

WATERWORKS SYSTEM

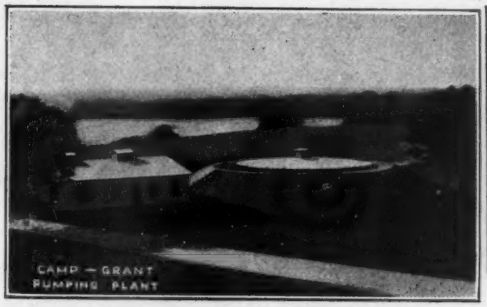
The water supply is obtained from six wells 10-in. in diameter and ranging in depth from 154 ft. to 185 ft. The water is drawn from a coarse sand stratum through Johnson brass strainers from 15 to 20 ft. in length.

The water is pumped from the wells by the air lift system, under a head of about 45 ft., to a circular concrete reservoir containing 300,000 gallons, from which the high lift pumps draw the water and deliver it to the distribution system. Air is supplied by three electric driven two-stage short belted Ingersoll-Rand air compressors, at present operating at about 60 lbs. air pressure.

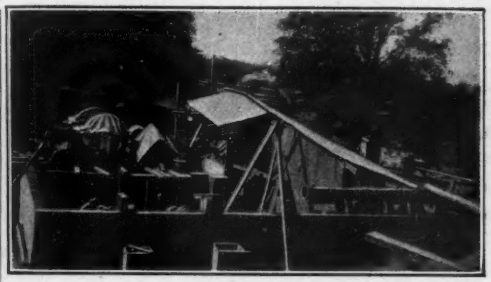
The high lift pumps are electric driven with the exception of one oil engine unit provided for emergency service. The station contains four electric driven centrifugals having a capacity each of 1,000 gallons per minute against 180 ft. head.

WHY THE AIR LIFT?

In the construction of the system of wells for the water works no time was available to explore the underground conditions by test wells



COMPRESSOR HOUSE AND RESERVOIR



WATERWORKS UNDER CONSTRUCTION

to determine what would be required as to well strainers, casings and well pumping equipment. It was necessary to anticipate all possible conditions and to place orders for all well casings and well drilling equipment that would possibly be required.

Experience in northern Illinois made it certain that a supply of water could be obtained in the St. Peter sandstone with wells about 500 ft. deep, but the time required to drill to this depth made it desirable to develop the water in the sand and gravel overlying bed rock, if this could be done. Experience in the City of Rockford was not favorable to these shallow wells. Therefore, it was not considered safe to make plans for a supply nearer the surface than the St. Peter sandstone. Accordingly, casings and well drilling equipment were mobilized for deep wells. At the same time accurate records were kept of the strata encountered from the ground surface, and a strainer was provided, so that if favorable materials were encountered, the strainer could be set and a well test could be made. Fortunately, the shallow supply was successful, and with the first successful well, additional strainers were provided and used in the remaining wells as rapidly as the drill rigs reached the water bearing sand.

Likewise in the design of the pumping equipment, provision was made for every contingency reasonably possible. In the light of developments, it would be possible to develop a supply by suction. It was known that this could be done before the work started, but if it had been necessary to develop water in the St. Peter sandstone, the supply per well by suction would have been so small that a large number of wells would have been required, thus defeating our purpose through the consumption of too much time. Furthermore, as a proposition for water supply during the period of war, it would be economy to construct a few wells and pump them deep, rather than a larger number of wells pumped by suction to a shallow depth.

For this reason, and further on account of its reliability, the air lift pumping system was adopted, and it was so designed that the desired supply could be pumped from a depth of 100 ft. if necessary. Fortunately, capacious wells in the sand and gravel permit of the required supply with a lift of about 45 ft., and, therefore, there is a reserve of capacity in the air lift pumping equipment in addition to one compressor unit held in reserve for breakdowns.

COOLING FORGINGS BY COMPRESSED AIR

A method of cooling forgings by compressed air, with decidedly beneficial effect upon the steel has been developed by J. W. Dunphy, a Canadian engineer. Steel containing 0.42 per cent carbon, 0.063 silicon, 0.034 sulphur, 0.025 phosphorus, and 0.48 per cent manganese, which with appropriate heat treatment when cooling under atmospheric conditions gave a yield point of 18 tons and a tensile strength of 36 tons per square inch with 27 per cent elongation, after being cooled by compressed air is said to have improved its yield point to 22 tons and its tensile strength to 44 tons per square inch with 25 per cent elongation. The forging was a 9.2 inch shell, and the air consumption 2100 cubic feet per minute. The air was used at a pressure of 80 pounds per square inch and was delivered from a pair of 2-inch pipes, plugged at their ends, surrounding the forging and with fifty 3/16-inch holes each on the side facing the forging, while a 3-inch pipe with one hundred

3/16-inch holes along its length and ending in a special nozzle to cool the nose of the shell, cooled the inside. It took five minutes to reduce the forging from furnace heat to 800 degrees Fahr. While being cooled it rested on a pair of 4-inch rollers, one of which was driven by a compressed air motor, while the other ran as an idler. The 3-inch pipe supplying the compressed air to the cooling pipes was about 10 feet long, and had a loose joint at the top, so that all the pipes could be lifted and swung away when the forging was changed.

Coals having different composition require different sizes of combustion space. The chemical characteristics that are most likely to affect the size of the combustion space required for a given set of conditions are the quantity and quality of the volatile matter. The quantity of the volatile matter is shown by its percentage as determined by the proximate analysis. The quality of the volatile matter is indicated approximately by the ratio of volatile carbon to available hydrogen, and probably also by the oxygen content of the coal on a moisture and ash free basis.—*Bureau of Mines Bulletin No. 135.*

SOME ENGINEERS*

Who is the man designs our pumps with judgment, skill and care?
Who is the man that builds 'em and who keeps them in repair?
Who has to shut them down because the valve seats disappear?
The bearing-wearing, gearing-tearing mechanical engineer.

Who buys his juice for half a cent and wants to charge a dime?
Who when we've signed the contract can't deliver half the time?
Who thinks a loss of twenty-six per cent is nothing queer?
The volt-inducing, load-reducing electric engineer.

Who is it takes a transit out to find a sewer to tap?
Who then with care extreme locates the junction on the map?
Who is it goes to dig it up and finds it nowhere near?
The mud-bespattered, torn and tattered civil engineer.

With compressed air and dynamite, who toils in dark and wet,
The copper, iron, coal and gold for all the world to get?
Who sinks his shafts and drives his stopes and makes the wealth appear?
The drilling, blasting, pumping, hoisting mining engineer.

Who thinks without his products we would all be in the lurch?
Who has a heathen idol which he designates Research?
Who tints the creeks, perfumes the air, and makes the landscapes drear?
The stink-evolving, grass-dissolving chemical engineer.

Who is the man who'll draw a plan for everything you desire?
From a trans-Atlantic liner to a hairpin made of wire?
With "ifs" and "ands," "howe'ers" and "buts" who makes his meaning clear?
The work-disdaining, fee-retaining consulting engineer.

Who builds a road for fifty years that disappears in two?
Then changes his identity, so no one's left to sue?
Who covers all the traveled roads with filthy oily smear?
The bump-providing, rough-on-riding highway engineer.

Who takes the pleasure out of life and makes existence hell?
Who'll fire a real good-looking one because she cannot spell?
Who substitutes a dictaphone for coral tinted ear?
The penny-chasing, dollar-wasting efficiency engineer.

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*[Mining engineer interpolated by C. A. M.] *Sung to the Tune of "Son of a Gambolier," at a Meeting of the Engineering Society of Buffalo.*

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

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We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

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I accept the challenge. I know that you accept it. All the world shall know that you accept it. It shall appear in the utter sacrifice and self-forgetfulness with which we shall give all that we love and all that we have to redeem the world and make it fit for free men like ourselves to live in. This now is the meaning of all that we do. Let everything that we say, my fellow-countrymen, everything that we henceforth plan and accomplish, ring true to this response till the majesty and might of our concerted power shall fill the thought and utterly defeat the force of those who flout and misprize what we honor and hold dear.

Germany has once more said that force, and force alone, shall decide whether justice and peace shall reign in the affairs of men, whether right as America conceives it or dominion as she conceives it shall determine the destinies of mankind. There is, therefore, but one response possible from us: Force, force to the utmost, force without stint or limit, the righteous and triumphant force which shall make right the law of the world and cast every selfish dominion down in the dust.—

OUR PRESIDENT.

WE ALL ARE IN THE FIGHT

These are the times when history is being made for only the far ages to fully interpret. On the face of things and in the rapid flow of events it is not easy to realize that up to the present this is the most critical and portentous period in the great life of the world, and that we of America are as fully involved as any. Our position as a nation is in like jeopardy and our future in the same uncertainty as that of the dwellers across the seas. At the present writing no man may deduce from the visible trend of events what is to be the outcome. And yet the sub-current of our national life is not greatly disturbed. All of life's activities are in full swing. The masses of our people are apparently as prosperous as ever within our memory, crowded with remunerative employment, and, the clouds and the thunders and the earthquake rumblings all ignored, there are those who still could dwell among us in smug content.

Nevertheless, there are few among us who are not seriously thinking and more or less realizing that a struggle for life is upon us. It is a thing absolutely unescapable. There is no possibility of giving up to or of settling with these reeking foes of the human race at any price. We must conquer completely or be hopelessly bound in practical slavery to foreign military tyrants for years uncountable. Such a step backward would be a reversal of the entire recorded course of the human race. Our way is upward and not downward. As the true American patriot never despaired of the republic so the true man of the world never despairs for humanity. All along the way, however, man has had to pay the price, too often in drenches of blood, and only ages after is it seen to be a bargain for us.

The progress of civilization, as we have been wont to call it, has had no more transforming effect than in the arts and conditions of warfare. The hero at the front was never more a hero and the risks to be faced were never so great. With a full realization of this all of America's young manhood is crowding forward as fast as it can be organized and equipped and transported. The assurance of ultimate success is all in the providing and equipping, and the soldier at the front is only a helpless victim if these shall fail him. This puts the responsibility upon us all, for we all have a hand in these things. A single battle may be won by the personality of the command and that of the men engaged, but even then they must be lavishly, unfailingly supplied with the swiftly wasting munitions and everything right at hand for their instant needs, while for the conduct of a campaign the requirements go far beyond our powers of enumeration. The call is for the product of all our factories and all our farms, the maintenance of financial stability, unwavering confidence and resolve whatever may befall, and this puts a burden of responsibility, commensurate with ability and opportunity, upon us all.

The New York subway, with 136 miles of track, hauls more than two and one-half times as many passengers as the number hauled by the Pennsylvania Railroad with its 26,000 miles of track. And the Pennsylvania stretches through thirteen states and the District of Columbia.

PREVENTING FREEZING IN AIR PIPING

It should be understood that what follows, from the *Electric Journal,* refers entirely to the air brake equipment of surface railway cars. Contrary to the general impression freezing is not so troublesome when the atmospheric temperature is very low as it is when only a trifle below the freezing point, because at low temperature most of the moisture has been frozen out of the atmosphere. The installation of air piping should be such that the maximum amount of moisture is retained in the main reservoir and no pockets should exist where moisture is liable to collect. The pipe between the compressor and the main reservoir, as well as the pipe between the two main reservoirs, should be at least 25 ft. long, and when the length of car does not permit a straight run the pipe should be made in the form of horizontal coils.

A scheme which is similar to the pipe coil, but having the additional advantage of multiple paths, is the arrangement of a number of tubes fastened into two heads or drums. One of these drums can be used as a moisture trap, preventing the major portion of the moisture from getting into the main reservoir. For a given length of piping with the same diameter in the two systems one arranged in the single path and the other in multiple paths, the single path will require a greater velocity and hence a greater loss in pressure for the delivery of a given quantity of air.

In connecting the feed pipe to the reservoir particular attention should be given to make sure that the connections do not give a reduction of pipe area at any point, as the change in area increases the possibility of freezing. One of the most common breaches in the proper method of making an air installation is to use an "L" fitting at this joint, which not only gives a reduction of area but forms a trap for moisture to accumulate. A better and much more satisfactory scheme for this connection is to have a straight run or large radius bend to the main reservoir where possible and use a connector which does not give a reduction in area.

All piping from the reservoir to the various pieces of apparatus should be arranged to drain back into the reservoir as far as pos-

sible, and when this is impossible it should at least drain away from the apparatus.

There have been a number of installations where the compressor intake has been mounted inside and, in some cases underneath, the car. The best place to mount the intake is on the roof, as it is then possible to obtain cool, clean air. More moisture is obtained from the interior of a car than from the exterior, especially on a cold day, because the higher temperature of the air within the car permits the presence of more moisture per unit of volume of air.

Even in the best installations it is impossible to prevent considerable moisture from getting into the system and to prevent trouble from this source a rigid inspection should be maintained during the winter. It is a good practice to drain the main reservoir at least once a day and oftener if possible.

VALVES FOR LITTLE COMPRESSORS

We have lately received the following:

"The writer has just patented a two-cylinder, rotary, hand-action, automobile tire pump. That is, it is a pump which has a central frame which fastens to the running board by a clamp. On the side of the frame is mounted an internal flanged gear; just such a gear as is used on the outside wheel of a lawn mower. On the other side of the frame are two gears which mesh with the internal gear. A pitman arm is fastened on each small gear. The pitman arms work the plungers in the pumps. The gearing is in the ratio of 2½ to 1, 40 revolutions of the large gear giving 100 impulses to each piston. The cylinders are about 1¼ by 2¾ in. each. The two cylinders are siamesd together at the top with connection to the tire. It therefore is necessary to have an intake and a discharge valve on each cylinder. The writer has used the regular ball and spring check, but finds it is not rapid enough. The information desired is this: A quick opening, easy spring valve with an opening at least ½ in. Do you know of such a valve, or where the writer might get in touch with any manufacturer who would show a line of air valves?"

In reply to this we can only say that the intake and discharge valves of all good air compressors are designed and located as part of the machine and no valve manufactured commercially for mutilfarious uses can be satisfactory. There are various check valves for steam or water which might be employed, but their application would involve so much clearance space that the delivery would be greatly reduced, and for high pressures with such little cylinders there might be no delivery at all. In fact, we venture the opinion that excessive clearance, and not slow action valves, is the cause of the trouble our correspondent encounters.

AIR CARRIED POWDERED COAL

Powdered coal pulverized and distributed by the Holbeck system is being used for heating 46 sheet and pair furnaces at the plant of the Standard Tin Plate Co., Canonsburg, Pa.. An interesting feature of the installation is the arrangement of coal dust collectors in both the distributing and pulverizing parts of the system. This is shown diagrammatically in one of the illustrations.

The pulverized coal is delivered to a main conveying duct and is carried in suspension in a continuous current of air, with branch lines leading to the furnaces. The conveyor duct forms a closed system through a return duct leading to dust collectors and thence to the air intake to the distributing blowers. Thus the only outlet is through the branch lines to the furnaces. The installation comprises two distributing blowers with inter-connected dust collectors and four pulverizers, which deliver coal through individual dust collectors to two powdered-coal storage bins. Two pulverizers supply a single bin. The illustration shows the arrangement of equipment attached to one of these blowers and pulverizers. The work of designing and erecting the equipment was done by the Bonnot Co., Canton, Ohio, under the personal direction of A. A. Holbeck, who is its chief engineer. Alterations to the furnaces to accommodate the system were made during shut-down periods on Saturdays and Sundays.

After running the sheet and pair furnaces for a period of several months it was decided to run a branch coal-dust main to an annealing furnace, also a similar line was carried to one of the tin pots in the tin house. Additional equipment for preparing and distributing powdered coal to 18 annealing furnaces and 50 tin pots is now being installed and in a few weeks the Standard Tin Plate Co. will use powdered coal in all its heating work.

The pulverized coal plant contains three 9-in.

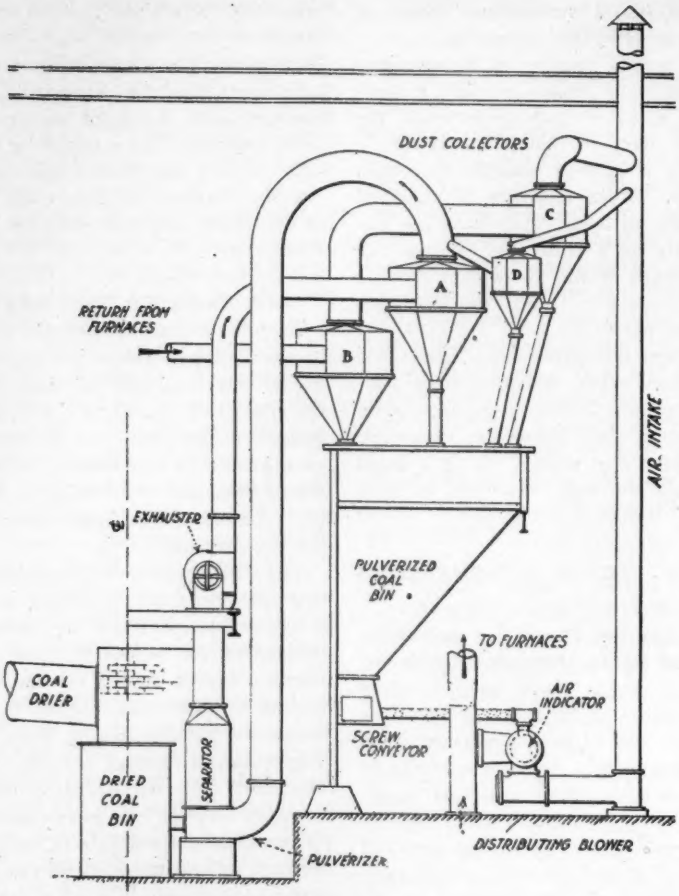


FIG. I

screw conveyors placed in concrete trenches. These receive the coal from the coal storage pocket and deliver it to an 18-in. belt conveyor. After passing a magnetic separator which removes all foreign matter the coal goes to a bucket elevator. This elevates and discharges it through a spout to an automatic registering scale which weighs and drops it to a drier.

This drier, which is hand fired, removes the moisture from the coal so that only ½ per cent remains. There is not much danger of the coal taking fire as the velocity of the gases is low due to the large area of the drier. Also, the drier is provided with dust-tight rings at each end to prevent dust leakage.

From the drier the coal is conveyed by a screw conveyor to the two dried-coal bins, one being placed between two Bonnot pulverizers. Each pulverizer has a capacity for pulverizing 2500 lb. of coal per hour to a fineness of 95 per cent through a 100-mesh screen and 85 per cent through a 200-mesh screen.

After being pulverized the fine coal dust is drawn through an air separator on the top of each pulverizer and discharged into dust collectors, one for each pulverizer. From these the coal dust drops to the storage bins while the air is drawn back to the pulverizers maintaining a partial vacuum in them. This, it is said, insures an absolute quality of fineness of grinding and incloses the system so there is no escape of coal dust to the atmosphere. Also the combustible gases released by pulverizing the coal are kept in the system and delivered to the suction piping of the distributing blowers.

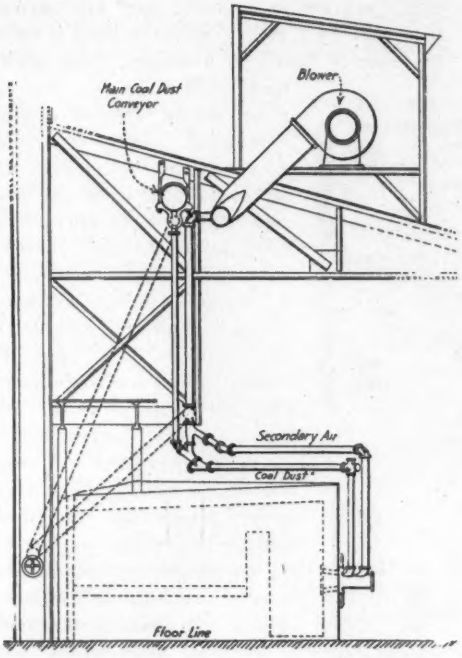


FIG. 2

The powdered coal is fed to a cast-iron high pressure distributing blower along with air in such proportion that it is carried by suspension through pipes to the different furnaces at a velocity of approximately a mile a minute. The coal dust and air traveling through the pipe form a non-combustible mixture which requires additional air for combustion of the coal. This is furnished under a small blast pressure at the coal burner.

The amount of coal dust and air fed to the distributing blower is governed by a regulator which in turn is governed by the volume of air flowing through the line so that irrespective of varying demands on the system a constant mixture of coal and air will be delivered to the distributing duct. The regulator controls the speed of a variable speed motor which drives the screw feeding coal to the blower. A float controls the free air admitted to the blower with the coal dust.

The distributing pipe for the 46 sheet and pair furnaces is 1480 ft. long and is carried up and over and through the roof trusses with branches dropping down at each furnace to supply the burners. The method of dropping a branch pipe to the burner and also the manner in which the supply of coal and secondary air are controlled by the furnace operator are illustrated.

Approximately 600 lb. of coal, it is said, were required per ton of steel heated with hand firing while with powdered coal this was found to be reduced to 280 lb. per ton.

The following notes will be of assistance in interpreting the illustrations:

Fig. 1. Dried coal after pulverization is delivered through an air separator to the main collector A, from which it falls to the coal storage bin. A screw conveyor carries it from here to a distributing blower, which takes in air through the air intake and delivers the mixture to the main coal dust conveying duct. Coal dust not taken by the furnace continues through the conveying duct, which returns to dust collectors B and C. These are open to the air intake, but the coal settles to the bin.

Fig. 2. A branch line from the coal dust conveyor and one from the secondary air supply unite at the burner at rear of furnace. Provision for regulation by the operator and the elevated blower for the secondary air line are shown.

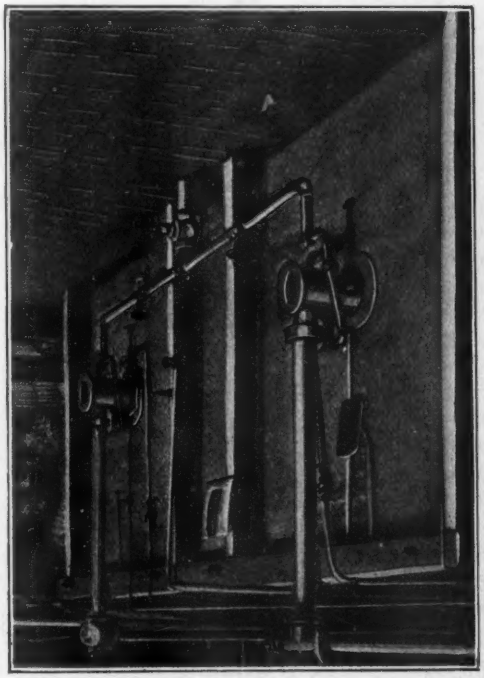
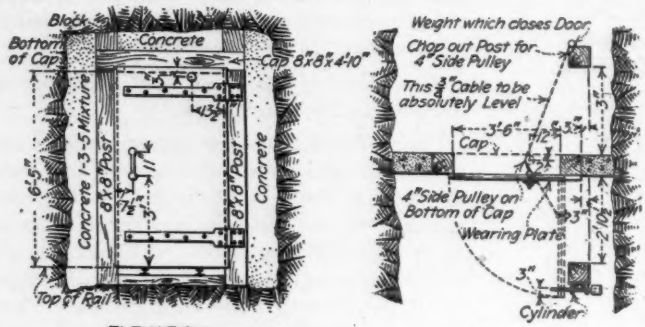
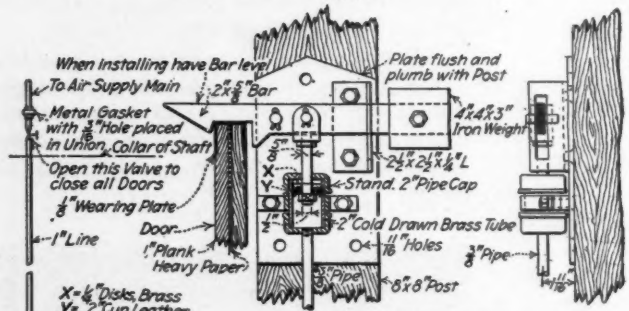


FIG. 3

Fig. 3. Burners at rear of sheet and pair heating furnaces, showing coal dust and secondary air supply.—*Iron Age.*



METHOD OF MOUNTING FIRE DOOR
FIG. 1



COPPER QUEEN FIRE DOORS

FIRE DOORS AIR-CONTROLLED AT COPPER QUEEN MINE

In a paper before the American Institute of Mining Engineers, Feb., 1918, Gerald Sherman, Supt. of Mining Dept., Copper Queen Consolidated Mining Co., Bisbee, Arizona, describes an ingenious arrangement for closing fire doors simultaneously all over a mine by simply opening an air valve anywhere on the system from the surface to the stopes.

A sketch of the doors is given in Fig. 1, and a diagram of the piping system through which they are operated is shown in Fig. 2. Fig. 3 gives details of the operating mechanism. The doors are set in concrete, and are normally held open by a latch; when the latch is raised, the door is closed by a weight. The latch is held locked by an air cylinder acting against a counterweight. The air cylinders connect by piping, with all doors protecting the shaft and with the compressed-air main on the surface. By opening a valve at any station, or at the surface, the air system is drained of air, the pressure on the cylinder falls, and the weight throws the latch and allows the doors to close. Any door, of course, may be opened by hand afterward. A small hole in a metal gasket furnishes enough air to supply leakage in the pipe system but not enough to prevent the fall in pressure when any valve is opened. By this arrangement, if anything goes wrong with the piping or air pressure, the doors close automatically; if the latches were thrown by cylinder pressure, instead of the reverse, they would fail in case of accident to the air line or its injury by the heat of a fire not quickly discovered. It is probable that the doors cannot be made air-tight, but if necessary they can be easily and quickly caulked by helmet men, after they are closed.

NOTES

The United States is by far the largest both producer and consumer of talc in the world, according to the United States Geological Survey. The softness, absorptive capacity, difficult fusibility and solubility, and electric resistance of talc make it one of the most generally useful of all minerals in the arts and industries. Its principal military use is to prevent sore feet among marching soldiers. Only pure ground talc should be used for this purpose. The demand for the "footease" grade of ground talc, which is now extensively used in the army, may be fully supplied in this

country. Although the war has stimulated production it has not greatly increased the price.

The following average weights per brake horse-power for various classes of engines were given in a paper by Mr. P. N. Everett, recently read at Newcastle on-Tyne:—Triple expansion steam engine for cargo boat (no boilers or auxiliaries), 130; triple expansion, including boilers and auxiliaries, 450; Diesel engine for cargo boat (no auxiliaries), 250; Diesel engine with all auxiliaries, 400; turbines, for cross-Channel boat with boilers and auxiliaries, 200; Diesel engines for submarines, 50; steam reciprocating engines for destroyers, 35; turbines for destroyers, with boilers, etc., 30; petrol engines for motor cars, 15; petrol engines for racing boats, 7½; aero engines, 2½.

An extraordinary engineering feat is under way at the quarry of the Morris County (N. J.) Crushed Stone Company. A tunnel about 70 feet has been dug under the mountain of rock considerably over 100 feet below the top of the rock. Lateral tunnels will be dug out from this main tunnel. Huge charges of explosives will be placed in these tunnels and at one blast over 30,000 cubic yards of stone will be crumbled. The face of the rock is 112 feet high.

A 9-ft. concrete-lined tunnel 7,000 ft. long is being planned for the City of Milwaukee. It will extend from the shore shaft of the new intake tunnel across the city to the proposed west side pumping station at Chambers street, on the west side of the Milwaukee River.

A new wood called balsa, growing principally in South and Central America, is remarkable on account of its lightness, microscopical structure, absence of woody fibre, elasticity and heat insulating qualities. So far as investigation has disclosed, it is the lightest commercially useful wood known. It has also considerable structural strength, which makes it suitable for many uses.

The new stack of the Tacoma Smelting Co. at Tacoma, Wash., exceeds all previous height records for chimneys. It rises 571 ft. above top of footing (just above ground level) and 601 ft. above foundation level. As it stands on a ridge about 150 ft. high, its top is 725 ft. above tidewater, only a few hundred feet away.

February 19, 1918, was the second birthday of the world's greatest gushing oil well. This well, which is almost the eighth wonder of the world, is the famous Cerro Azul No. 4 in the Mexican fields of the Pan-American Petroleum & Transport Co., of which E. L. Doheny, of Los Angeles, is president. Before it was capped and the flow controlled 260,858 barrels of oil had been tossed high in the air.

Completion of the 12-ft. Wilson avenue intake tunnel at Chicago marks an important step in the increase of water-supply for that city. The tunnel extends in solid rock three miles under Lake Michigan to an intake shaft and crib, and five miles under the city to a new pumping station. It is of horse-shoe section, 13x13 ft. for one mile from the intake shaft, and 12x12 ft. for the remaining seven miles.

In the best roundhouse practice locomotives of the larger types can be thoroughly cleaned in from seven to ten minutes by washing them with a combination of fuel oil and water sprayed through a nozzle by compressed air.

A process has been developed for production of gas from straw. An equipment for a farm will include a retort, scrubber and gasometer, and cost approximately $500. The straw is compressed in bales of necessary size. Gas begins to come off at approximately 200 deg.; a maximum temperature between 500 and 600 deg. is necessary. The gas is entirely removed in from 30 to 45 minutes. Each ton of straw produces between 10,000 and 11,000 cu. ft. of gas, also six to eight gallons of tar and ammoniacal liquor. Part of the gas is used in carbonizing the straw, leaving approximately 7,000 cu. ft. available. The gas has a calorific value of about 400 B.t.u. per cubic foot. One ton of straw gasified leaves about 600 pounds of carbon residue, which could be converted into lamp black or other carbon products. An experimental plant has already successfully produced this gas.

LATEST U. S. PATENTS

FEBRUARY 26

1,257,354. VACUUM VAPOR-HEATING SYSTEM. Henry J. Hunt, Chicago, Ill.

1,257,460. PRESSURE-REGULATOR. Lucian W. Cushman, St. Joseph, Mo.

1,257,470. APPARATUS FOR THE LIQUEFACTION AND RECTIFICATION OF AIR. Hendrik Filippo and Pancras Schoonenberg, Eindhoven, Netherlands.

1,257,527. AIR-PUMP. Gregory Victor Piotrowsky, Buffalo, N. Y.

1,257,584. PROCESS FOR PICKLING OLIVES. William V. Cruess, Berkeley, Cal., dedicated, by mesne assignments to the Government of the United States and to the people of the United States.

5. The process for pickling or curing olives which consists in subjecting the olives to a lye bath, and subsequently subjecting the olives in a tank to a heated liquid carrying minute particles of air in suspension, continuously withdrawing the liquid from the bottom of the tank, continuously adding air to said withdrawn heated liquid and intimately mixing said air and heated liquid and causing the mixture to flow back into the tank continuously.

1,257,591. PROCESS FOR PREPARING FERTILIZING MATERIAL. Thomas A. Dungan, Chicago, Ill.

1. The herein described improvement in the art of forming fertilizer from sterilized organic material, which consists in inoculating the material with aerobic bacteria and permitting the bacteria to develop while continuously forcing air through the mass.

1,257,607. METHOD OF COMPRESSING AIR OR GASES. Herbert Alfred Humphrey, Westminster, London, England.

1,257,688. PULSATOR FOR MILKING-MACHINES. Robert Bruce Forsyth, Christchurch, New Zealand.

1,257,741. PRESSURE-REGULATOR. Percy Russell, Philadelphia, Pa., and Adoplh W. Schramm, Riverton, N. J.

1,257,744. ROTARY PUMP OR COMPRESSOR. Robert Schorr, San Francisco, Cal.

1,257,753. FLUID-OPERATED MOTOR. William A. Smith, Denver, Colo.

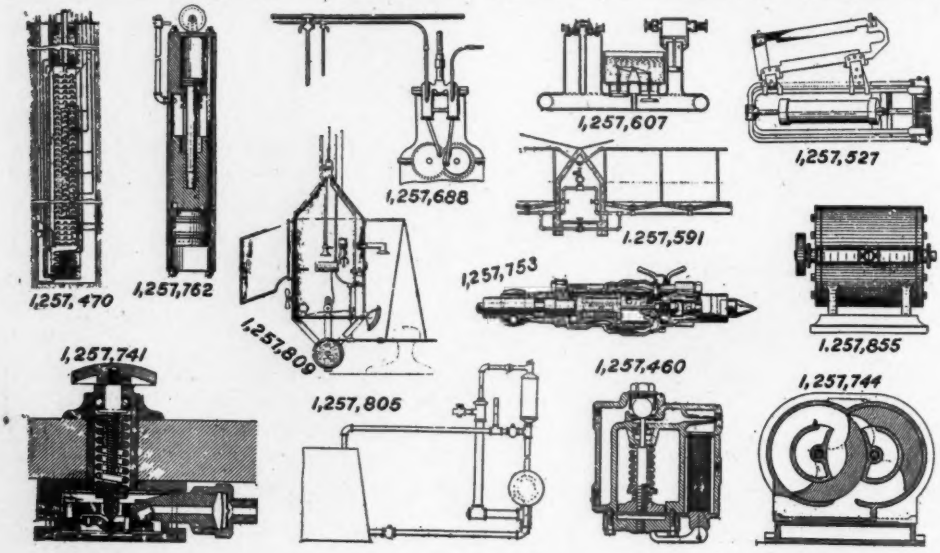
1,257,762. SUBAQUEOUS PILE - HAMMER. Thomas E. Sturtevant, Dover, N. J.

1,257,805. VACUUM FLUID - CIRCULATING SYSTEM. Sebastian L. Calvert, Augusta, Kans.

1,257,809. DIVING-BELL. Arnaldo Ceretti, Montreal, Quebec, Canada.

1,257,855. AIR-COMPRESSOR. Arthur Leonard Harrison, Victoria, British Columbia, Canada.

1. An air compressor comprising, a stationary cylinder having a spiral groove in the bore thereof and provided with diametrically located inlet and outlet passages for each end, a piston rotatably mounted in said bore and having pins slidably engaging the said groove at diametrically opposite points whereby rotation of the piston causes its reciprocation, means for rotating the piston, and means operated by the rotating piston for opening an inlet and an outlet passage at opposite ends of the cylinder simultaneously.



PNEUMATIC PATENTS FEBRUARY 26

MARCH 5

1,258,033. AUTOMATIC CLOSING DEVICE FOR FIRE-DOORS. Frederick W. Martin, New York, N. Y.

1. In a fire door apparatus, the combination of a door, a cylinder and piston for operating the door, said cylinder having a normally open admission port, a manually operated valve for controlling the supply of fluid through said port, an expansion chamber, and a valve operated by the pressure in said chamber for automatically closing said port at a predetermined time after the opening of said manual valve.

1,258,060. VACUUM FUEL-FEEDING SYSTEM FOR GASOLENE-ENGINES. Harold C. Suckert, New York, N. Y.

1,258,079. SAFETY-VALVE FOR PNEUMATIC TIRES. William J. Young, Minetto, N. Y.

1,258,105. AIR PUMPER OR MOTOR CIRCULATION-CHECK. Robert A. Gally, Cincinnati, Ohio.

1,258,206. PNEUMATIC TOOL. Martin B. Fetcher, Detroit, Mich.

1,258,277. COTTON-PICKER. Walter Gee Upchurch, Nashville, Tenn.

In a cotton picker structure, the combination, of a cotton receiving chamber, means for

removing cotton from said chamber including a pair of air suction fans having outlet pipes, flexible members communicating with inlets of said fans, a forked nozzle, the arms of said nozzle connected to said outlet pipes, said flexible members extending into said chamber whereby the cotton will be drawn therethrough into said fans and out through said forked nozzle upon operation of the fans.

1,258,342. AIR-VALVE FOR HOISTS. Joseph J. Justen, Milwaukee, Wis.

1,258,355. PNEUMATIC RUNNING - GEAR FOR VEHICLES. Thomas J. Mullen, New Brighton, and Thomas F. Brennan, Tompkinsville, N. Y.

1,258,399. PNEUMATIC SELECTIVE DEVICE. Lewis B. Doman, East Syracuse, N. Y.

1,258,407. AIR-COMPRESSOR. Stirling B. Hill, Seattle, Wash.

1,258,422. PNEUMATIC-DESPATCH-TUBE APPARATUS. Ernest J. Loring, Somerville, Mass.

1,258,835. PUMP. George Washington, Ann Arbor, Mich.

1,258,855. FLUID-OPERATED PERCUSSIVE TOOL. Lewis C. Bayles, Easton, Pa.

1,258,864. AIR STARTING-GEAR FOR COMBUSTION-ENGINES. Alfred Buchi, Winterthur, Switzerland.

1,258,892. METAL-BENDING MACHINE. Alvah M. Griffin, Kansas City, Mo.

1,258,912. APPARATUS FOR MIXING FINELY-DIVIDED MATERIAL AND AIR. Alonzo G. Kinyon and Arthur I. Jacobs, Chicago, Ill.

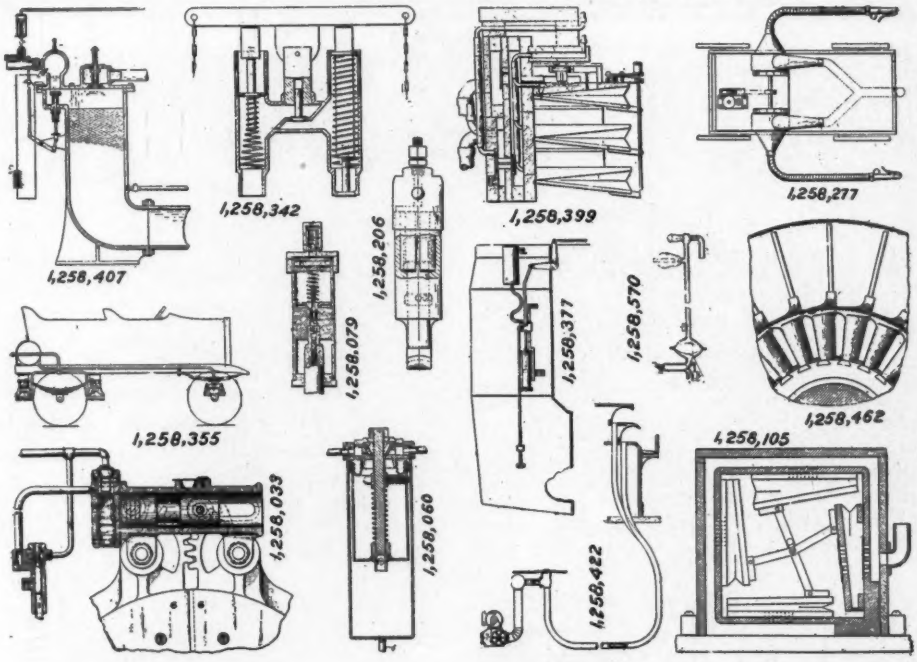
1,258,998-9. DRILL-SHARPENER. Jesse Ditson, Littleton, Colo.

1,259,045. DRILL - SHARPENER. Theodore H. Proske and Alexander L. Proske, Denver, Colo.

1,259,118. AIR-COUPLING. Homer L. McFarland, Conway, Mo.

1,259,201. BOAT. Worth R. Barringer, Grand Junction, Colo.

3. A vessel of the character described in-



PNEUMATIC PATENTS MARCH 5

1,258,462. CENTRIFUGAL COMPRESSOR. Richard H. Rice, Lynn, Mass.

1,258,570. APPARATUS FOR UTILIZING AN EXPANSIVE FORCE. Herbert Alfred Humphrey, London, England.

MARCH 12

1,258,713. APPARATUS FOR PRODUCING POWER. David H. Smalley, South Pasadena, Cal.

1. In combination, a cylinder, a piston in the cylinder, means to introduce a combustible charge into the cylinder behind the piston, means to introduce a charge of air into the cylinder in front of the piston, means to ignite the combustible charge, and means including tubing extending between opposite ends of the cylinder to transmit some of the heat of combustion to the charge of air when said air has been compressed by the piston.

1,258,769. TORCH. John Harris, Cleveland, Ohio.

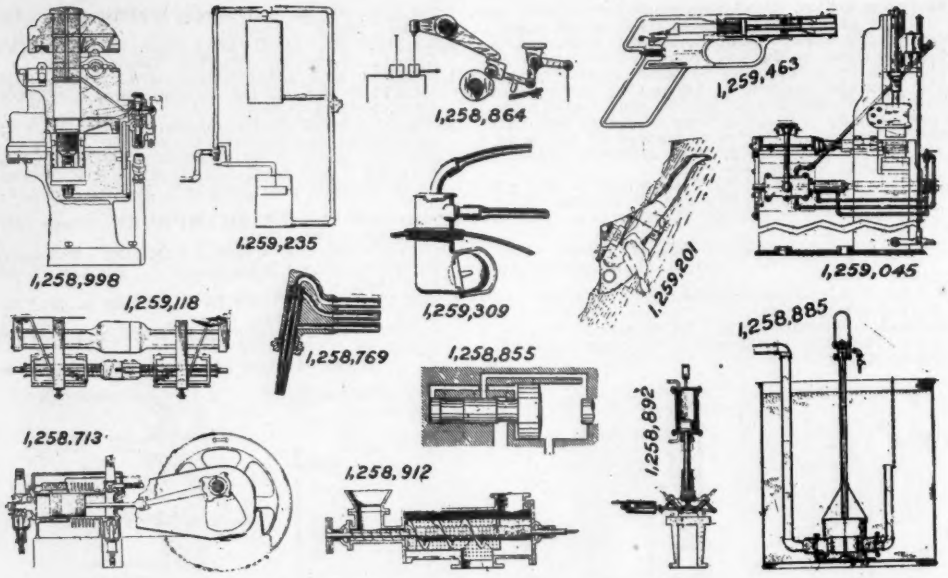
cluding a body portion open at one end and having means to support a body of a person therein, a closure plate for the open end of said body, flexible leg receiving envelops secured to said plate, a propeller for the vessel, a compressed air operated motor operatively connected to the propeller, said body being provided with an engine compartment, and a gas engine therein also operatively connected to the propeller.

1,259,235. VACUUM-REGULATOR FOR OIL-PUMPS. James W. Hobbs, Burkburnett, Tex.

1,259,291. AUXILIARY AIR-VALVE. Brainard G. Rich, Colville, Wash.

1,259,309. MILKING-MACHINE. Charles E. Somers, Milwaukee, Wis.

1,259,317. AUTOMATIC AIR - INSPIRATOR. Henry A. W. Thomasson, South Bellingham, Wash.

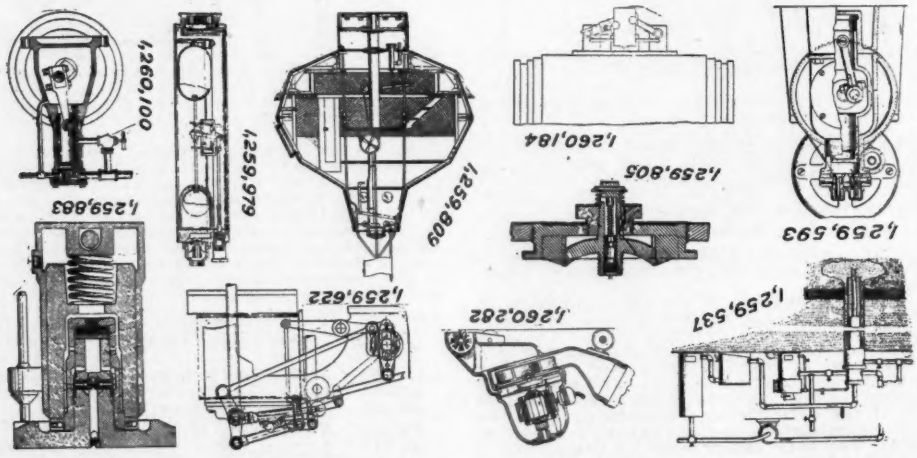


PNEUMATIC PATENTS MARCH 12

1,259,409. PNEUMATIC HAMMER. Hugh F. Jones, John E. Lane, and Edward M. Lillie, Ray, Ariz.
1,259,463. AIR-GUN. Jesse De Fir, Paragould, Ark.

MARCH 19

1,259,537. MINING SULPHUR. Anthony F. Lucas and Godfrey M. S. Tait, Washington, D. C.
1,259,593. AIR - COMPRESSOR. Henry J. Bery, Detroit, Mich.
1,259,622. PNEUMATIC SHEET - LIFTING DEVICE FOR AUTOMATIC SHEET-FEEDERS OF PRINTING-MACHINES. Heinrich Heenss, Berne, Switzerland.
1,259,737. FLUID-PRESSURE BRAKE SYSTEM. James A. Hicks, Atlanta, Ga.
1,259,805. COMBINED AIR INLET AND EXHAUST VALVE. Reason C. Tharp, Osceola, Mo.
1,259,809. LIFE-BUOY. Albert Atwood Unruh, Portland, Oreg.
1,259,883. MOLDING - MACHINE. Wilfred Lewis, Haverford, Pa.
1,259,979. HYDROPNEUMATIC PUMP. Benjamin Samuel Hampton Harris, Greenville, S. C.
1,260,100. GAS - COMPRESSOR. Louis N. Udell, Chicago, Ill.
1,260,101. AIR-BREAK COUPLING. Oren J. Vickers, Gasparilla, Fla.
1,260,184. FLUID-OPERATED VALVE MECHANISM. John C. Glenn, Erie, Pa.
1,260,282. MEANS FOR AIR-COOLING MOTORS. Harmon H. Harrold, New Philadelphia, Ohio.



PNEUMATIC PATENTS MARCH 19